COUNTER-MAPPING FOR CONSERVATION: DIGITAL CONSERVATION ATLAS CASE STUDY

by

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Abstract

Counter-Mapping seeks to empower communities to overturn the power dynamics of mapping by sharing a visual representation of space in a way that is accessible to the public and that presents utility to community conservation goals.

Within a participatory action framework in partnership with the Yellowstone to Yukon (Y2Y) Conservation Initiative and local First Nations and communities, I built a web-accessible spatial mapping 'hub' for the Peace River Break region of BC. Through interviews with conservationists, First Nations and other community members, I examined the pitfalls and barriers communities in the Peace region face with mapping and mapping technology for conservation, including the case study atlas itself. A GIS-facilitated conservation strategy can address and integrate multiple voices, views and understanding of local conservation desires in the context of larger conservation visions such as Y2Y, but building a tool and engaging communities to use it pose very different, and unique, challenges.

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1.0 Introduction

1.1 Conservation, Connectivity and Collaboration

Conservation of wildlife and ecosystems as a concept, discipline, and policy is built upon understanding the importance of wildlife and wilderness for humans and other species alike. Conservationists are often motivated to work to ensure that natural areas and wildlife will be maintained for the benefit of future generations. In the past, conservation theory has focused on the protection of special places, generally seen as 'pristine' and conforming to cultural views of primeval, untouched nature. Natural beauty was a primary criterion along with large, charismatic wildlife such as Grizzly Bears. Conservation has evolved to focus more on the concept of biodiversity, the variability within and amongst species and ecosystems (National Research Council US, 1999, p.2). Critical to conserving biodiversity is protecting habitat. Habitat conservation is a discipline and practice that seeks to conserve, protect and restore habitat areas for wild plants and animals in order to prevent their extinction (Noss, et al. 1997)

Large landscape conservation comes from the idea that maintaining biodiversity and healthy wildlife populations depend not only on the existence of core habitats but also on the maintenance of connectivity among them across distances that outstrip the features of a single place or habitat. Connectivity contributes to healthy biodiversity across landscapes in many ways, including maintaining healthy genetic exchange between wildlife populations, sustaining predator-prey systems, and enabling migration both seasonal and long term so wildlife can make necessary journeys in search of new homes, and new mates (Aengst, 1999).

The goal of planning a network of protected areas to represent the diversity of ecosystems has been a central idea of conservation planning for some time (Groves et al, 2002, p 499). In Canada, conservation planning has increasingly moved from the hands of government at all levels, to increasing leadership from First Nations communities and civil society represented by Environmental Non-Government Organizations (ENGOs), with a corresponding empowerment of public interest groups and other stakeholders in pushing for protection of areas or wildlife of value (Groves et. al, 2002, p 500).

This neoliberal governance model of conservation has traditionally focused less on direct leadership of the protection of new areas and rather on management of landscapes for multiple interests, primarily economic, and then responding or reacting to campaigns launched by ENGOs, First Nations, and local communities to protect species and wild areas of high value, rather than systematic planning based on the best science (Haenn and Wilk, 2006).

In North Eastern British Columbia, the Peace River region is an important example of where these issues are reaching a point of crisis. Situated in the narrowest point of the Rocky Mountain range, the Peace River Break (PRB) area is a critical ecological zone and one of very few areas with an east-west road and rail link over the Rockies in northern BC. The Peace River Break represents a key connection between the Muskwa Kechika Management Area to the northwest and the Canadian Rocky Mountain Parks to the southeast—both of which are core refuges for threatened species such as grizzly bears (Figure 1). The region has a long and rich history of use and occupancy by First Nations communities—communities that depend on the land, wildlife, and ecosystems for past and future prosperity. In addition to high agricultural, recreation and tourism values the Peace River Break is also well known for

industrial economic activity centered on mining and the energy sector including oil, gas, coal, coal-bed methane, hydro-electric and wind power, employing thousands of people from the region and beyond.

Although comprehensive government-led land use planning was completed in the area during the late 1990s, there have recently been major changes in land use/industrial development in the area. The natural gas industry, forestry, mining, and new wind and hydroelectric development have all expanded rapidly in the early 2000s. Since 2001, there has been no further leadership direction from governments on expanding conservation and protected areas in the region, likely due to a perceived need to cut regulations to facilitate industrial development of natural resources, chiefly oil and gas, on the land base. The industrial development pressures in the Peace Break are immense and development is rapidly underway without full knowledge of compounding local and cumulative effects (Penn, 2013).

This situation has resulted in a concerted effort from ENGOs and community groups such as the Peace Valley Environment Association, and led by First Nations, such as West Moberly First Nations, to push for a 'rebalance' between development and conservation on the landscape. Chief among the challenges faced by these groups are that the ecological, conservation and human use (e.g., traditional use, recreation/tourism use) values are not comprehensively reported upon. Existing information is difficult to access, held by myriad sources, and not available in a single place for community stakeholders in the region. The lack of an integrated, accessible information resource means that sufficient analysis cannot be done to inform important questions such as identifying critical wildlife crossings, maintaining ecosystem connectivity, identifying core conservation areas, and assessing the cumulative impact of rapidly expanding industrial development in the region.

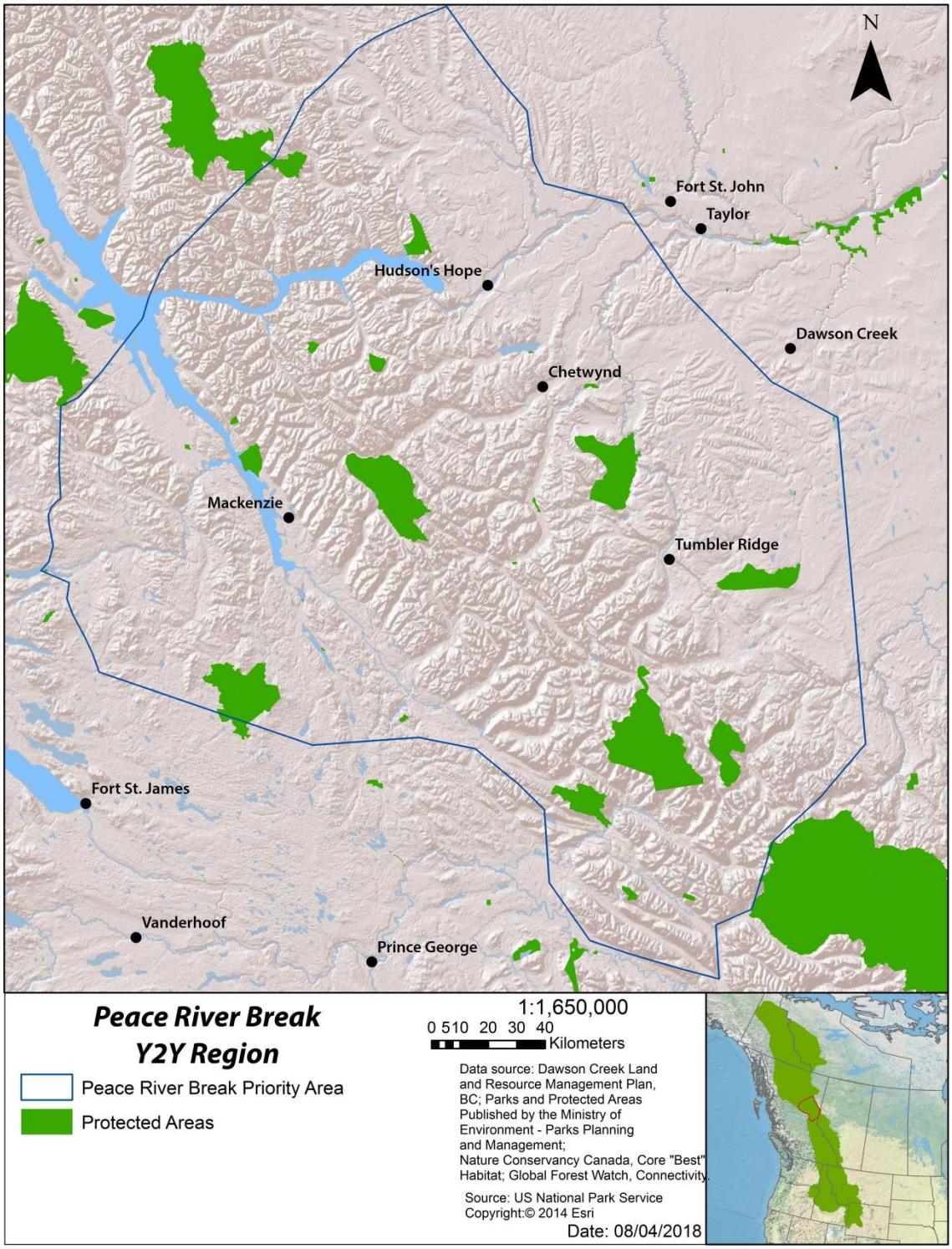

Figure 1. Peace River Break Y2Y Region. Tim Burkhart, 2014.

1.2 Conservation and Technology

Information technology, specifically digital mapping and remote sensing technologies, has changed the conditions for the design of conservation areas and the opportunities and challenges for environmental advocacy and action. "The advent of GIS brought the power of the computer to the collection and analysis of data, allowing [conservationists] to understand, interpret and visualise spatial and temporal relationships" (Cameron, 2014).

For environmental movements, establishing an innovative online presence to drive public education about conservation causes is necessary in an increasingly digital world. he integration of social networking, geo-visualization, and conservation data into a single online platform represents a tremendous opportunity for conservation movements to support public engagement with conservation practices and efforts, and empower local communities to take a lead in decision-making over protecting their landscapes. GIS technology presents unique opportunities and challenges for conservation research, as it provides a powerful tool for articulating visions of protected space and for equipping environmental movements with quantifiable, visual productions of their stated goals. "It allows [conservationists] to look at scenarios, ask questions about species and the landscapes they live in, and approach complex issues that are, by nature, spatial. It is an analysis tool that helps to visualise problems and communicate findings" (Cameron, 2014). With the rising importance of GIS to conservation, questions have arisen as to the potential for the marginalization or alienation of communities and individuals who do not have the expertise required to understand and use the technology. If these barriers force communities to rely on outside experts to navigate the technological challenges on their behalf, these communities and individuals cannot engage as fully equal stakeholders or land-use planners in the processes that shape the landscape.

These questions extend to the practice and principles of conservation mapping. Complimentary with the development of local knowledge from direct interaction with the environment, more decisions and expectations, by decision-makers, are based on an indirect conceptualization of the environment and landscapes. These decision-makers base their interaction with the land primarily through computer screens or printed maps, often in cities far from the land being examined itself. "GIS-facilitated conservation mapping will inevitably privilege certain spaces, features, species or ecosystems for protection over others, and also create boundaries of success" (Harris & Hazen, 2006 p.12). The concept of counter-mapping is intended to address this criticism, arguing that GIS technology can enable and empower communities to change the dynamic by sharing a visual representation of space in a way that is accessible and understandable to the public and that presents utility to community conservation goals (Cochrane, Corbett, & Keller 2014, p.10). A GIS-facilitated conservation strategy can embrace a new reflexive epistemology that addresses and integrates multiple voices, views and understanding of local conservation desires in the context of a larger, regional conservation vision.

Another criticism of GIS technology is that it captures a specific version of reality which is anchored within a Wester, first-world, expert-driven, science paradigm (Yapa L., 1998, Pulsifer et. al, 2011, Rundstrom 1995). Including qualitative forms of knowledge is a challenge for GIS practitioners, and social scientists who recognize the potential of the technology for enhancing their disciplines, and for "understanding and representing the multiple realities of space and environment" (Harris & Weiner, 1998 p.70, Pulsifer et. al, 2011, Cope & Elwood, 2009).

GIS technology is not limited to only the representation of specific features on the land base, and can be exploited in a reciprocal fashion to map a diversity of worldviews (Pulsifer et. al, 2011, Kwan, M. P., 2002). For example, GIS and spatial visualization technology can enable the transformation of text and stories into maps (Bodenhamer et al., 2010). The ability to represent narratives in a GIS database raises issues of how transporting and translating local and traditional knowledge impacts the cultural value ascribed to these traditions, and has the potential to alter meaning and importance to the community (Pulsifer et. al, 2011).

Issues of accessibility, privacy and the politics of information are consistently raised in the literature. Questions raised include: What, and whose, data are captured and included? How are data utilized? Who is involved in the production and control of the information? Whose spatial worldviews are being represented is important in any mapping project (Harris & Weiner, 1998)? I chose a framework for thesis research that is grounded in an attempt to understand these questions and the challenges they present to my research communities and the aspects of privilege that GIS expertise and technology can create.

1.3 Research Purpose

Digital atlases have the potential to be a powerful tool for ecological protection and public engagement. User-driven, web-based cartographic technology can improve access and empower communities to take more of a lead in decision-making over their land, air and water. Through a case-study approach centered on a participatory action framework, I created a digital atlas to provide a place for conservation and land-use facets that was accessible and available to the public, and allowed for the visualization of these facets at various scales. As a novice to GIS myself, it is also fitting that in learning the technology, I have worked to

respect and combine the skills I developed with the knowledge of research collaborators and communities, working at the direction of the non-profit organizations, grassroots movements and individuals that requested the digital atlas.

The purpose of this research was to examine the opportunities that a digital conservation strategy presents for better informing conservation research, decision-making and advocacy, and how this strategy can be designed in the spirit of counter-mapping to be user-informed, community-driven, transparent and accessible. This research examined the following questions:

1. How can a digital atlas enrich the data for conservation area design and bring more people in local communities into the process?
2. Can a social media component to a digital atlas help to identify information, both scientific/technical and traditional/community knowledge, for conservation planning?
3. How will a digital atlas be used by conservationists, local communities, First Nations, and other potential users?

1.4 Thesis Structure

This thesis examines the use of a digital atlas mapping tool for conservation in the Peace River Break region of north east British Columbia. It examines the development of this tool, and the themes emerging from discussions around the need for and experiences of mapping in this region. The report has been organized into 1) Chapter 2, a review of the existing literature of map theory, counter-mapping, and digital mapping tools, 2) Chapter 3, a detailed description of the methodology used; a case study digital atlas project through which I engaged three communities of interest, in a semi-participatory action framework 3) Chapter 4,

a description of the case study digital atlas project, and the development of the digital atlas project itself, and results of the case study atlas and how the communities of interest used it, 4) Chapter 5, a description and interpretation of findings from informant interviews conducted among the communities of interest, and how a digital atlas can be used for conservation advocacy, and; 5) Chapter 6, lessons and recommendations for developing a digital atlas and for future research and conservation action.

2.0 Literature Review

2.1 Deconstructing the Power of Maps

Critical map cartography offers a theoretical foundation to examine the role of the mapping process in the development of conservation strategies. Through this literature, which casts maps as inherently political documents with inherent biases, the actors, resources and social relations that enable map production can be examined to analyze what relations and power a map itself produces (Harris & Hazen, 2006). Maps have always been utilized by nation-states for the consolidation of control over land and people, and the cataloguing of the landscape and citizenry for taxation and supervision (Rocheleau, 2005). The development of the concept of the map as a political document comes from postmodern critiques of cartography, which center on the concept that maps are socially constructed texts that must be negotiated and understood in the context of the power and ideology inherent in map-making (Harley, 1989).

A postmodern deconstructionist critique questions the assumed neutrality of the discipline and products of cartography itself—that mapping is an unbiased scientific discipline which seeks only to represent the world accurately (Harley, 2009). Deconstructionist tactics such as those identified by Harley can dismantle the association between reality and representation which dominates the science of cartography and provides it with an intrinsic, accepted place as 'normal science' (Harley, 1989). Despite the case made by Harley and others that maps can often be far from objective representations of the world, this assumed neutrality has come to be the popular default societal understanding of maps. For modern maps, the science of geography itself has the intrinsic authority (developed through legitimate endeavour and the advancement of cartography and surveying) to become this symbolic realism, which is just as

effective a stamp of political authority and legitimacy as coat-of-arms or a portrait of a queen placed at the head of an earlier decorative map (Harley, 1989). According to the postmodern critique, maps hide and deny their inherent social dimensions at the same time as they legitimate the view of the world that is presented (Harley, 2002). The fundamental premise assumed by the prevailing epistemology of cartography is that maps offer, or attempt to offer, a scientifically accurate window into the real world; maps rarely fail to advertise their own authority within their frame (Wood & Fels, 1992). Wood and other contemporary postmodernist critics of cartography argue that all maps legitimate a specific socially constructed worldview, and by understanding this created legitimacy, the arbitrary nature of some maps can be exposed: "once it is acknowledged that the map *creates* these boundaries, it can no longer be accepted as *representing* these realities" (Wood & Fels, 1992 p19).

The theoretical pillars in this exercise in deconstructing the hidden socio-political agendas of cartography that Harley relies upon come primarily from Michel Foucault and Jacques Derrida (Huff, T.E., 1989). "Foucault's anchoring of texts in socio-political realities that influenced their author and creation and Derrida's 'rhetoricity of all texts', which together search for metaphor and rhetoric in maps and mapmaking where previously scholars had found only measurement and topography" (Harley, 1989). It is the process of map-making—and the rules for the cultural and technical production of maps—that Harley found particularly interesting: the organization and classification of information, what is selected and especially what is omitted, and in the development of map symbology. The application of maps and how they work in a society as a form of power-knowledge, indicated to Harley a subjective social purpose rather than standing for some underlying essential law of scientific cartography (Harley, 1989; Verymeylen et al., 2012; Wood & Fels, 1992). A deconstructionist view of

cartography emphasizes critical reading of maps and the theory surrounding mapmaking to uncover the unsaid contradictions and imperatives that challenge the intrinsic authority and honesty that maps purport to present to their audience (Harley, 2002).

Crucial to this methodology of deconstructing maps is a critical examination of the process of map making itself and the selective inclusion of knowledge and information to be included and displayed. The ways the land and features are represented through various rhetorical styles and technical processes can be seen as means of expressing control over the image of that landscape. The deconstructionist critique therefore sees maps as instruments of power used to impose the biases and desires of their creators upon the landscape itself (Harley, 1989).

While this deconstructionist approach to investigating cartography is valuable in understanding the inherent power and ideology invested within the map-making process, other critics of cartography argue that it fails to "conceive of the map as other than a representation of reality…never able to understand that the heart of the problem wasn't the way the map was wielded but the map function itself" (Wood, 1993, p.50). Rather than focusing on the ways in which maps are wielded as instruments of power or social construction, these critics argue that maps are inherently political texts whose prejudices and omissions are impossibly tied to the nature of their production (Wood, 1993). For these critics, maps are a system of propositions with varying degrees of social assent; propositions that fix places spatially in the reader's mind, and in translating them the map imposes its reality upon the landscape (Wood & Fels, 2008).

Maps are the potential vehicles for the production and communication of authority about and over territory. Every map proposes its authority and factuality, only the nature of the authority and its production varies (Wood & Fels, 1992). The map is able to remain undisputed as a way of presenting the reality of a landscape, while presenting itself as an image or reflection rather than a "self-consciously fashioned representation that must conform to certain conventions in order to be taken seriously" (Bryan 2009, p.30).

Historically, this authority and its associated construction have typically been political in nature. Harley labelled cartography the "Science of Princes"; map production was for centuries a tool of state power (Harley, 1989). While some simple topographic maps can be seen as value-free reflections of the world, most maps are never free of the value and intent of the individuals and societies that created them. "Both in the selectivity of their content, and in their styles of representation," writes Harley, "maps are a way of conceiving, articulating, and structuring the human world which is biased towards, promoted by, and exerts influence upon particular sets of social relations." (Harley, 2001, p.53) As map production has historically been initiated by government, maps can be perceived as emphasizing and bolstering, and crucially, enabling, the exercise of power through decision making and enforcement of "the legal statutes, territorial imperatives, and values stemming from the exercise of political power" (Harley, 1989, p.12).

As cartographic scholarship increasingly reflects the acknowledgement of the inherent social constructions of maps, a different challenge has arisen with the advent of technologies that can manage and visualize data in a spatial environment. Geographic Information Systems (GIS) technology offers a view of the physical environment "seemingly stripped of its cultural assumptions"; it is intended to be, as with topographic maps, a program to provide a platform

for unbiased representation of the land (Bodenhamer et al., 2010, p.17, Weller, 2012). GIS found among its first proponents quantitative geographers who recognized the technology's ability to manage large quantities of data and the potential of visualizing spatial analysis (Bodenhamer et al., 2010).

The technology has many levels, from analysis to visual representation, and can be characterized at many different scales. It is a community of research that is inherently transdisciplinary; a new way of conceptualizing space and place. GIS is a powerful group of tools and technologies for the collection, manipulation and visualization of spatial data (Pickles, 1995; Crampton, 2009). GIS expands the map from just building a representation of the world for navigation or administration, to the collection and analysis of data, allowing users "to understand, interpret and visualise spatial and temporal relationships" (Cameron, 2014).

New technologies always present society with new anxieties and new opportunities, and GIS has been no exception. Academic rifts opened as GIS use exploded across disciplines, as a conflict grew between those scholars who saw GIS as the portend of a major shift in scientific methodology and those who sought to use it to extend existing geographic methodology (Bodenhamer et al, 2010; Schurmann, 2000).

The primary critique of GIS is fundamentally the same offered by earlier critics of map-making processes: that it rests on a "positivist and naïve empiricism" (Taylor, 1990, p.211). GIS, "while well equipped to manage information, is inadequate in the realm of knowledge production, concerned with facts but incapable of meaningful analyses" (Taylor, 1990, p.211).

The controversy surrounding the interpretation of GIS and the future of geography scholarship grew with a collection of essays critical of the epistemology being built around the technology. Critics outlined a litany of concerns, primarily that the technology would inevitably privilege specific spatial understandings of the world, particularly Western, scientific ones, and that as GIS is a corporate and militaristic product relying on data developed by the state, much the same as modern cartography in general, it would therefore represent and perpetuate specific understandings and viewpoints of socio-economic, cultural and political power (Harris & Weiner, 1998; Bodenhamer et al., 2010; Chrisman, 1987).

> "GIS [can] privilege certain ways of knowing the world and imposes its own conceptual and logical models – filtered by user and the technology – GIS [can] marginalize other ways of knowing – in particular local community knowledge (largely represented in qualitative forms) leading to structural knowledge distortion." (Harris, 2009, p.5)

While these criticisms are valid, they did not take into account how the technology might also be used to co-opt and disrupt these 'particular views', how the rapid diffusion of spatial information technology and increasing accessibility via the internet across the globe, and across disciplines, has the potential to turn the "Science of Princes", into a "Science of the Masses", though challenges to doing so remain (Peluso, 1995, Chapin et. al, 2005).

2.2 Participatory GIS and Indigenous Counter-Mapping

Understanding the power inherent in mapping outlined in the previous section is critical to examining the strategies employed to challenge, co-opt, and counter it. Maps are powerful political tools, especially so in policy discussions related to land-use, resource economics,

Indigenous rights, and conservation priorities (Harley, 1989; Colchester, 2005). The interactive approaches and methods broadly grouped as Participatory Geographic Information Systems (PGIS) draws upon local people's knowledge, enabling participants to create data and visualize it in a spatial database. As maps communicate information immediately and add authority to information, these methods provide communities with confidence and legitimacy in dealing with power structures and outsiders (UNEP-WCMC, 2013). Community-based mapping projects present opportunities for traditionally marginalized groups to participate in discussions and decision making of space and land-use normally dominated by state and corporate maps, typically created for development and exploitation of natural resources, as well as a means of affirming local agency for the governance and local exploitation of those same resources (Alcorn, 2000). At the grassroots, especially in the developing world and Indigenous communities, communities are using maps to resist the interests of powerful entities, such as the state and corporate maps have traditionally tended to serve (Collective, Dalton, and Mason-Deese, 2012).

Participatory mapping techniques became more feasible in the post-colonial period, starting in the 1960s and 1970s, as spatial data, typically under the control of state institutions or capital, became progressively more available to non-governmental entities such as community-based organizations, minority groups, and parts of society that were typically dispossessed by and barred from mapping decision-making processes (UNEP-WCMC 2013). Gathering and availability of this data is a crucial undertaking for engaging in these processes. Technological advances combined with a growing interest in conserving traditional land-use and including local communities in decision-making processes encouraged Indigenous peoples and their supporters to start their own counter-power mapping practices (Vermeylen et al., 2012;

Cooke, 2003; Craig et al., 2002; Kyem, 1998). This movement to build empowerment mechanisms through spatial representation technology has become more necessary for communities seeking to defend their own decision-making power of their land, air and water. "A map can only be challenged by another map, and the effectiveness of the challenge is based on the geographic authenticity of the map makers," essentially saying, "either you map or are mapped" (Nietschmann, 1995 p.212).

First coined by political ecologist and forest policy researcher Nancy Peluso in 1995 to characterize maps developed by forest dwellers in Indonesia, the term *counter-mapping* describes grassroots efforts to produce maps that counter colonial and neo-colonial cartographies that dispossess Indigenous communities from their land and resources (Peluso, 1995). Counter-mapping can be characterized as any type of mapping that challenges traditional power structures such as government or capital to further progressive goals, and increasingly describes grassroots community efforts to produce maps as a tool to take greater decision-making power over their land and water (Harris & Hazen, 2006; Rundstrom, 1995; Taylor, 2008). Maps are one of many resources produced by the state or hegemonic power to consolidate that power and it is a creative and powerful political act for local communities, particularly marginalized ones, that appropriate cartography and the tools of state power to work to counteract or offset this monopoly of power (Peluso, 1995).

Counter mapping can enable and empower communities to turn the power dynamic of mapping on its head by sharing a visual representation of space in a way that is accessible and understandable to the public and that presents utility to common community land-use goals (Taylor, 2008). It is subversive in that it co-opts the state or other traditional artifacts of power structures manner of representation to enhance the legitimacy of traditional community claims

to resources (Peluso, 1995). Counter-mapping is a concept that is built where Indigenous social movements, and increasingly popular social movements in general, intersect with the development of participatory action research methodologies and the expanding access of digital cartographic technologies, specifically GIS (Wainwright & Bryan, 2009).

The profusion of participatory GIS and the counter-mapping narrative has not been without criticism. Many have argued that the requirements of mapping privilege the Western, Euclidean worldview over Indigenous conception of space and territory, and the technological requirements of modern GIS serve to create new gatekeepers for Indigenous peoples and local communities in the experts and technicians typically employed by NGOs or in academia (Rundstrom, 1995, Harris & Weiner, 2013; Rocheleau, 2005; Wainwright & Bryan, 2009). Community-based mapping efforts are prone to co-option by researchers, consultants or NGOs utilizing the maps and techniques for their own project goals, and these goals may not entirely align with those of the communities (Alcorn, 2009).

This is the primary criticism of counter-mapping as a practice. While co-opting the cartographic tools that the state and other hegemons used to manifest control of land can serve to re-balance power relations, it also serves to entrench Western, First World concepts of bounded territoriality and often includes only that traditional Indigenous knowledge which is compatible with this worldview and the technology itself (Escobar, 1998; Neumann, 1995). Boundaries are often also a fluid concept for many Indigenous communities, and there is a tendency for them to become static and fixed when translated into Western maps (Aberley, 1993; Bryan, 2011; Vermeylen et al., 2012). The perceived validity of Indigenous spatial knowledge and its related value are tied to its usefulness to the established (Western) natural and social science in general that form the basis for the modern state (Escobar, 1998;

Nietschmann, 1995). Participatory mapping can have the unintended consequences of increasing intra-community conflict or land-privatization, as well as the potential for increased surveillance and regulation by the state or other power structures (Alcorn, 2009; Fox, 1998). Counter-mapping therefore may require rethinking the process and the bounds of the cartographic discipline entirely, as even mapping with the specific intent of upsetting traditional power relations between the state and marginalized group is ultimately conditioned by legal, social and political norms (Wainwright & Bryan, 2009). This critique resonates with the discourse of critical cartography which presents maps as social constructions, with their propositions and narratives, silences and omissions, inscriptions, and disclosures (Bryan, 2009; Wood & Fels, 1992).

To examine mapping as a political act is to unravel the narrative contexts together with the truths and lies that have been generated in maps (Wood & Fels, 1992). Indigenous peoples' mapping practices should not escape this deconstruction (Wainwright & Bryan, 2009). Such maps are undoubtedly useful as part of strategies for political or territorial claims and advocacy, as well as in influencing management and policy over land-use and the environment, "creating new opportunities for recognition that remain dependent on colonial accounts of the past" (Bryan, 2009, p.29).

2.3 Mapping in Conservation Area Designs

Some of the most influential applications to conservation biogeography are the map productions that outline planning foundations for protected areas, which provide a powerful tool for communicating biogeographic theory (Whittaker et al., 2005). The marriage of conservation biogeographic theory with increasingly powerful cartographic visualization and

mapping tools manifest in GIS has provided a strong framework for the identification and coding of ecological priority areas and planning for protected areas at multiple spatial scales and is reflected in the priorities of global conservation organizations (Zimmerer et al., 2004). Linking landscape features with ecological processes can now be automated with computer modelling and integrated with GIS for location and visualization, as well as narrative and non-static purposes (Chen, 2006). Ecosystem mapping portrays ecological units, unique combinations of hierarchically ordered environmental factors that are rated as habitat for priority flora and fauna (Johnson & Gillingham, 2004). These tools may also enable conservation strategies to be adapted dynamically in response to fluctuating threats and policy decisions, as well as adapt to incorporate different representations of realities over time, such as Indigenous or local knowledge and worldviews.

Ecoregional conservation planning, conservation area designs (CAD, not to be confused with computer assisted drafting) and other similar tools are broad-scale approaches to conservation planning that utilize science-based information to analyze and identify priority areas for conservation, connectivity and wildlife habitat management (Noss et.al, 1997). The design of conservation priority areas requires the integration of ecological and biophysical data with social and cultural information to identify human and population pressures and strategies for effective planning and management, and increasingly, conservation planning techniques have been adapted to include traditional or local knowledge as critical decision-making information (Heinemeyer et al., 2003; Balram et al., 2004, Ruiz-Mallén, & Corbera, 2013).

A systematic approach to conservation area design aims to use objective measures and algorithms for selection that work to assess the strengths and weakness of different candidate areas to determine ecological value and identify priority areas for protection, special

management or connectivity (Margules & Pressey, 2000; Harris & Hazen, 2007). However, such conservation planning tools and approaches can also been criticized as being overly large, time consuming, and technical to produce and often requiring too much technical expertise and resources to facilitate flexible scenario planning and public accessibility (Peterson et al., 2003). Models of broad landscape systems and units can become overly complex, data-heavy and require heavy support that runs the risk of usurping the intent or focus of the planning itself (Chen, 2006).

Typical CADs are developed by a select group of content and GIS experts and can only be manipulated by them, and often require significant investments in time, training, hardware and technology infrastructure. Similarly, advancements in cartographic visualization technology often are directly focused upon highly specialized user groups, particularly academics or consultants, and this privilege of expertise can produce familiar power imbalances and biases that are reflected in the cartographic product (Rød et al., 2001).

A counter-mapping approach recognizes and incorporates this criticism, arguing that GIS technology can empower communities to turn the power of mapping towards developing and sharing a visual representation of the land in a way that is transparent, accessible, shareable and enhance local conservation efforts.

2.4 Counter-Mapping Conservation

While counter-mapping still primarily refers to Indigenous cartographic efforts, it was increasingly being applied to non-Indigenous mapping initiatives in economically developed countries (Rundstrom, 1991). The rise of counter-mapping can be framed as part of a growth of place-based social movements around the turn of the 21st century, which focused on

defining, representing, and creating meaning of places with the understanding that these will ultimately condition who will and will not have access to and control over the land (Fox, 1998). In this sense, counter-mapping can be used to create maps designed by grassroots organizations or local communities for the purpose of environmental advocacy.

As maps are powerful political tools for environmental and ecological governance and policy discussions, counter-mapping provides a framework for repurposing the map's intrinsic legitimacy and authority to enhance these community-based or grassroots conservation campaigns (Alcorn, 2000).

Counter-mapping theory also poses significant critiques of how protected areas are designed and created, such as how the process of mapping suggests that certain spaces are appropriate for protection for conservation, and how the relative 'mappability' of different areas or landscapes encourages the protection of certain features over others (Harris & Hazen, 2006; Anthamatten & Hazen, 2007). While the goals of protected areas are to preserve ecological systems, the imposition of fixed spatial boundaries can have the unintended effect of interfering with fluid ecological systems and processes (Chapin, 2004; Harris & Hazen, 2007; Andelman & Fagan, 2000). Understanding how to use mapping technology to move beyond the protected area concept and develop a paradigm shift in conservation practice and theory that recognizes and supports landscape heterogeneity, linkages across boundaries and ecosystems and processes is an important result of participatory and counter mapping (Chettri, et. al. 2007).

Conservation and ecological mapping practices can serve to enhance or entrench unequal power relations and dispossess people from traditional land-use practices (Peluso, 1995;

Escobar, 1998; Agarwal, 2001, Agarwal and Redford, 2009). The transfer of the guardianship of land through a conservation process can also dispossess local communities or Indigenous peoples, and create resistance to conservation due to displacement (Awuh, 2015). This raises questions about how much social license conservation NGOs have in determining the appropriate use of land for protection, and how the altered space of a bounded territory set aside for "nature" bias future access to the landscape (Katz, 1998; Hodgson & Schroeder, 2002, Awuh, 2015). Even many seemingly neutral maps such as maps of soil type, precipitation, topography, or flora and fauna can become the basis for land-use and classification which can be readily used for exclusive or hegemonic zones of management, with associated regulation or prohibition of various forms of traditional land-use that may have importance to local communities (Brosius et al., 2005).

Maps may spatially entrench public understandings of where conservation and protection must be placed, ignoring the dynamic nature of ecological conditions and specific conservation requirements for various species and enable a divestment of responsibility in other areas (Harris & Hazen, 2006). Conversely, in the policy-making of protected areas, maps are rarely the final say in land-use designation, and battles over protected spaces must constantly be re-fought as development interests seek to chip away at the borders of and uses within protected areas (Whittaker et al., 2005).

Critical assessments of the strong reliance on boundaries and reserves for conservation design can provide insight into how to better tailor protected areas to meet broader conservation goals and also examine the critical role mapping plays in the development and negotiation of conservation strategies. The challenges of delimiting conservation objectives within specific, fixed boundaries may point to new and creative strategies, such as a focus on integrating

conservation and sustainability within urban or agricultural landscapes (Harris & Hazen, 2006, 2007).

2.5 Counter-Mapping and Geo-Social Media

The expansion of readily available internet access and user-driven content online has created a sea-change in digital map production. Collaborative and open techniques based upon the volunteered input into common internet resources have the potential to offer a radical and new alternative to traditional mapping (Perkins & Dodge, 2008; Vidal-Filho et al., 2013). Characterized as "Volunteer Geographic Information", crowd-sourced web-based cartography such as Google or Bing maps represents a major shift from the traditional state-initiated and driven map production that has hitherto been the status-quo (Elwood et al., 2012; Haklay, 2010). These are tools that have been described as part of a democratization of cartography (Hallisey, 2005). Complimented by free open-sourced and user-driven tools such as OpenStreetMap, they represent a new trend that takes the act of mapping from the state and puts it instead in the hands of internet users, or corporations. The state is increasingly looking to private actors in the public provision and dissemination of cartographic services (Peck & Tickell, 2002; Haklay, 2010). Corporations, non-government entities, and individual citizens are now undertaking the mapping practices and functions that have long been the exclusive purview of state mapping agencies (Leszczynski, 2012).

This process can be characterized as part of a general neo-liberal trend towards the passing of government-dominated services to the hands of individuals and corporations (Peck & Tickell, 2002). Primarily limited to a regulatory body, the modern state is increasing seen as just an intermediary between individual citizens and the private sector (Caquard, 2013; Leszczynski,

2012). The consequences of this shift are up for debate. While some argue that so-called cartographic democratization may lead to an increased general understanding of how maps and map displays function both as tools for exploring the landscape and as devices for communicating knowledge about these world (Rød, 2001), there is likewise a concern that such a trend transfers the authority of mapmaking into the hands of a new and unaccountable power structure, which is engaged in the cartographic project for the opportunities for capital accumulation (Leszczynski, 2012).

For conservation, this trend presents new opportunities and challenges. The proliferation of web-based, user-driven or crowd-sourced mapping technologies has the potential to fit into a counter-mapping framework, by empowering communities to turn the power of mapping towards developing and sharing a visual representation of the land in a way that is accessible and understandable to the public and that offers a method of exploring and enhancing community environmental goals (Elwood et al., 2012; Harris & Hazen, 2006). However, potential pitfalls exist in exacerbating the divide between experts and laypeople and between communities and NGOs with regards to ownership of geographic information and technical map production (Elwood, 2009).

In addition to open-sourced projects such as OpenStreetMap and corporate mappings such as powerhouse Google Earth, numerous issue or place-specific atlases have sprung up online, representing various scales and intentions, including collaborative conservation tools such as DataBasin.org[1], the North American Ecological atlas[2] and others. Beyond the participatory

[1] http://www.databasin.org
[2] http://www.cec.org/tools-and-resources/north-american-environmental-atlas

and collaborative nature of these atlases, there have been some strides towards utilizing this technology to visualize a variety of geospatial perspectives in a style that encompasses both the physical geography and historical and cultural narratives, such as the Cybercartographic Atlas of the Lake Huron Treaty Relationship Process (Caquard, 2013).

While examples such as these are promising for situating digital atlases into a new web-based counter-mapping framework, considerable challenges still remain. While the so-called emergence of geo-social media—geographic data created through the merger of web-based mapping and social media—and volunteered geographic information may be changing the way the world can be visualized and shared, these changes are not equally available to or involving all citizens (Huang, 2009; Caquard, 2013; Kelley, 2013). Critics point to the over-representation of privileged, educated and primarily male elite producing and interacting with geo-social media, and the corresponding disproportional effect on the quantity of data produced by these actors, and the types of activities through which data is developed (Caquard, 2013; Haklay, 2013).

Just as the state and its particular interests dominated the production of maps for much of history, this new paradigm of cooperation between private technology companies and a relatively small but engaged user base is now the driving force of building a spatial reality through digital geographic media (Caquard, 2013). As a result, collaborative mapping projects with a digital component have the potential to merely reproduce existing power structures or be used for profit by third parties, which may contributing to the affirmation, reproduction and reinforcement of specific political and socio-cultural principles, rather than usurping them (Harley, 1989; Elwood, 2009). However, if they are designed in the spirit of counter-mapping

to be user-informed, community-driven, transparent and accessible, digital atlases have the opportunity to be a powerful tool for ecological protection and public engagement.

3.0 Methodology

To answer my research questions, I used a Participatory Action Research framework centered on a case study of the Digital Conservation Atlas. The participatory, collaborative and community-driven nature of this project supported a participatory action framework for the project, as conservation partners in the community, non-profits and industry were a part of the process of developing the project as 'co-researchers,' and the research was intended to reciprocally aid community conservation goals. I then used a combination of semi-structured informant interviews with members of three 'communities of interest' introduced to the digital atlas case study, as well as my own notes and journal of my experiences in developing the atlas itself.

3.1 Case Study: Design of a Digital Conservation Atlas for the Peace River Break

A case study is a method which enables the researcher to examine a complex issue through examination of a single case or project (Johannsen, 2003). An important tool in social sciences, the role of case study method in research is especially useful in issues community-based problems (Zainal, 2007, Johnson, 2006). In this project, a case study opportunity was presented through a community of interest involved in discussions and planning for land-use and conservation in the Peace River Break (PRB) region of northeast British Columbia.

In partnership with Yellowstone to Yukon Conservation Initiative I developed an accessible, shareable spatial mapping tool using the Data Basin platform to guide and inform the design of conservation and protected areas strategies for the critical Peace River Break region in Northeastern British Columbia (Figure 1, p. 4). This project was designed to facilitate the open exchange of critical conservation information and impart the value of having a clear

conservation strategy between partners, the public, stakeholders and policy-makers. By illustrating the role that geo-visualization can play in engaging public support and awareness of conservation priorities, the digital conservation atlas project presented an opportunity to bring together the science of conservation with the political advocacy work key to successful development of protected areas. Through a transparent conservation mapping process with a reciprocal, participatory action partnership with local conservation constituencies, the digital conservation atlas project attempted to inform future conservation planning in the region and illustrate priority areas for conservation campaigns.

The need for a shareable spatial mapping tool was developed as an outcome of a series of collaborative public workshops led by Yellowstone to Yukon Conservation Initiative centered on the PRB. The Peace River Break is a critical pinch-point and narrowest part of the Yellowstone to Yukon corridor, with a vast, wild, and diverse array of wildlife and habitat values but also intensive resource development. Cumulative effects have pushed the landscape to the brink of resilience for multiple species (Apps, 2013). First Nations have brought multiple lawsuits against governments in opposition to cumulative effects and individual projects negatively impacting the exercise of rights guaranteed under Treaty 8. Y2Y and UNBC, in consultation with West Moberly First Nations, held a series of workshops in 2008 and 2013 with the objective of working towards a shared conservation vision for the Peace River Break region and a strategy for its achievement.

The most recent workshop, held in March of 2013, was cohosted by UNBC's Natural Resource and Environmental Studies Institute (NRESi) with active participation from Treaty 8 First Nations, Peace Valley Environment Association, government and many other partners. The vision centered around "conserving remaining core wildlife habitat along the Rocky

Mountains, providing secure wildlife habitat linkages north-south and east-west, and protecting river corridors, while implementing best practices and limiting the cumulative impacts of industrial use" (Y2Y & NRESI, 2013). Achieving this vision requires focus on not only the ecological values of the area but also treaty and aboriginal rights. In addition, the vision recognized that it must include sustainable livelihoods of those resident in the area, planning for and providing opportunities for tourism and recreation for residents and visitors, and working to improve and reduce the impacts of industrial practices.

The community partners and workshop participants identified that central to achieving this vision was the development of a comprehensive, web-accessible geo-database for the Peace River Break that brings together a combination of community and traditional knowledge and values along with scientific and technical information in a spatially-based geographic information system. Based on the principles of conservation biology and informed by local knowledge this information was intended to be used to help shape comprehensive conservation planning and implementation strategies for the Peace River Break to help identify areas of high conservation value, including areas of high habitat quality for key species and movement corridors.

The research and case study project were designed to explore and examine the opportunities that a digital conservation strategy presents for better informing conservation research, decision-making and advocacy, and how this strategy can be designed in the spirit of counter-mapping to be user-informed, community-driven, transparent and accessible. This research examined how a suite of social spatial mapping tools can both enrich the data for conservation area design and bring more people in local communities into the process.

The specific objectives and desired outcomes for the digital conservation atlas project were to

1. Identify information needs, both scientific/technical and traditional/community knowledge for conservation planning in the Peace River Break;
2. Identify who and how information is likely to be used (including potential analysis) and identify sensitive information/intellectual property concerns with data;
3. Explore methods of mapping, sharing and displaying a mix of scientific and community-based/traditional information;
4. Identify available/accessible data layers (and/or existing spatial analysis) that address information needs identified in objective 2;
5. Assess data gaps and to identify easily accessible data to fill those gaps; and
6. Develop the Data Basin Atlas and distribute it for review.

These were the procedural objectives for the digital atlas project, but they did overlap with my research questions as outlined in Chapter 1. This case study project was an opportunity to examine the effectiveness and representativeness of a digital conservation atlas in delivering results for community conservation goals, and the potential for this type of geo-social technology to support broad community engagement and participation in the spirit of counter-mapping.

3.1.1 Data Basin

Digital mapping tools (and the emerging power of social media and cloud-based data storage) designed to support ecological protection and public engagement in conservation planning, are an innovative solution to problems in collaborative environmental planning. In

conservation science, mapping and spatial analysis are a fundamental part of research, analysis and planning (Cameron, 2014). One of the principal critiques of conservation area designs is that the accessibility of data, which is a fundamental component of conservation planning (mapping, spatial modelling and analysis), is often lacking; information is widely scattered, difficult to locate, and often unavailable (Comendant et al., 2009).

Time, resources and technological expertise must be spent in identifying data custodians, locating important biological, cultural, and economic datasets, scientific analysis, and gaining access to them (Comendant et al., 2009). As conservation problems become more serious and the demand to solve them grows more urgent, new methods of connecting science and practice become necessary; an environmental data and software platform operating in the cloud (a network of computer servers used for remote data storage), accessible over a high speed network, that can allow users to share, build, design and collaborate spatially on environmental issues, for free (Cowan, Alencar & McGarry, 2014).

In 2010 a multi-disciplinary team of scientists, software engineers, and outreach staff at the Conservation Biology Institute (CBI), in partnership with the Environmental Systems Research Institute (Esri) and the Wilburforce Foundation (a private charitable foundation), launched an open-access, web-based spatial data platform called Data Basin (www.Data Basin.org). Data Basin was primarily built to support scientific and geographic research and environmental resource planning and is an interactive web-based system that allows users to download, print, combine, comment on, or otherwise use the maps, data layers, and other information provided within (Comendant et al., 2009). Understanding the need to integrate the mapping power of GIS applications with the ability to share information over a social network, Data Basin "allows users to integrate, analyze, and communicate about the

distribution, status, trends, risks, threats, and factors affecting priority wildlife, plants, cultural resources, and ecosystems" (Miewald, 2014, p 1).

The open-access and web-based nature of Data Basin presents an opportunity for community or grassroots counter-mapping projects to "explore, create, interpret, and collaborate around their priority topics and geographies" (Data Basin, 2010, p.1). It provides a suite of tools for collaboration: Projects focused around a particular geography or conservation issue can develop "groups" that can be used to upload and share data, set permissions on data sets, and collaboratively visualize map products (Miewald, 2014). An online resource designed to increase the effectiveness and efficiency of landscape scale conservation and management, Data Basin provides a new platform with a social component to engage local communities in counter-mapping practice (Miewald, 2014).

Data Basin is designed for users to quickly be able to access datasets, experts, other users and analytical and display tools to help in environmental and conservation planning around the globe. It provides a vast library of conservation datasets, the ability to share information, maps, and analysis across the platform with other users or organizations. The web mapping tool also allows users to produce customized maps using information from the Data Basin library, uploaded datasets or datasets provided for use by other users.

> "Data Basin also houses individual centers that provide direct access to data, maps, and experts focused on specific geographic areas or conservation topics. Current centers being developed include the Boreal Information Centre, the Data Basin Climate Center, and proposed Aquatic and Forest Conservation Centers." (Comendant et al., 2009)

The Data Basin platform potentially allows grassroots organizations to have the tools necessary to take the initiative in designing the geographies from a conservation perspective they would like to see on their landscape, and tell more complete and authoritative stories, as

well as their own versions, regarding land-use and conservation, with the ability to bring the perceived legitimacy of science-based maps and analysis. The platform provides controls for the use and display of sensitive or proprietary datasets as well: “Data Basin encourages sharing and publishing, but also provides privacy and security for sensitive information when needed” (Comendant et al., 2009). This is primarily dealt with through a rigorous data import process that is handled through administrative approval and Data Basin requires all spatial data (biological, physical, and socio-economic) uploaded to its libraries to be well-documented through metadata (Comendant et al., 2013). This is important in maintaining legitimacy and scientific rigour and trust in the tool. Organizations and individuals utilizing this type of tool can reach and engage wider audiences and look for support from other organizations and experts that may otherwise be unavailable due to distance or resources.

The CBI and Esri have also worked to make the tool accessible to less technical audiences, with a simple and fairly straightforward and intuitive interface that is more technical than platforms such as Google Maps or OpenStreetMap, but still designed to be friendly to novices to GIS. Input from users is considered in the planning, testing, and implementation of the system and its ongoing development. Data Basin’s team provides regular outreach and training through webinars that are used to convey the scope and appropriate use of the scientific information and available resources (Comendant et al., 2013).

Data Basin is ultimately a data discovery, visualization, and analysis platform for stakeholders—it is a tool designed to be user-informed, community-driven, transparent and accessible, while being backed by technical expertise of Esri and the CBI. It has the potential to be a powerful tool for counter-mapping practice in the conservation sector (Miewald, 2014).

3.2 Overview of Methods

For data collection, I conducted qualitative semi-structured interviews (consultations) with 15 key informants involved in the design of previous conservation plans or similar analysis and with partners and stakeholders in the Peace River Break region to identify information needs, mapping approaches, data display/sharing techniques, and potential data usage needs. I employed participant observation techniques—notation of emergent themes, such as 'counter-mapping' or 'barriers/accessibility' from interviews—in order to collect and codify data generated in key informant interactions around the planning, design and communication of the project case study, including through electronic communications, phone conferences and other meetings. An overview of methods can be found in Figure 2.

The development of this project started in December, 2013, at the BC Protected Areas Research Forum conference in Kamloops, BC. I met with representatives of the research community to assess data needs and to determine the platform for the digital atlas, to be Data Basin. From January to April, 2014, I began collecting datasets from dispersed sources to populate the Data Basin tool. On April 7th, 2014, I launched the Data Basin Digital Atlas publically, and produced a newsletter for Y2Y/NRESi workshop participants in July, 2014. In addition, I was interviewed on CBC's Daybreak North program to promote the tool in July, 2014. Starting in February, 2014, I began informant interviews with members of the constituencies of interest in the Peace region. These interviews continued throughout 2014 and 2015, with the final interview taking place in August, 2015.

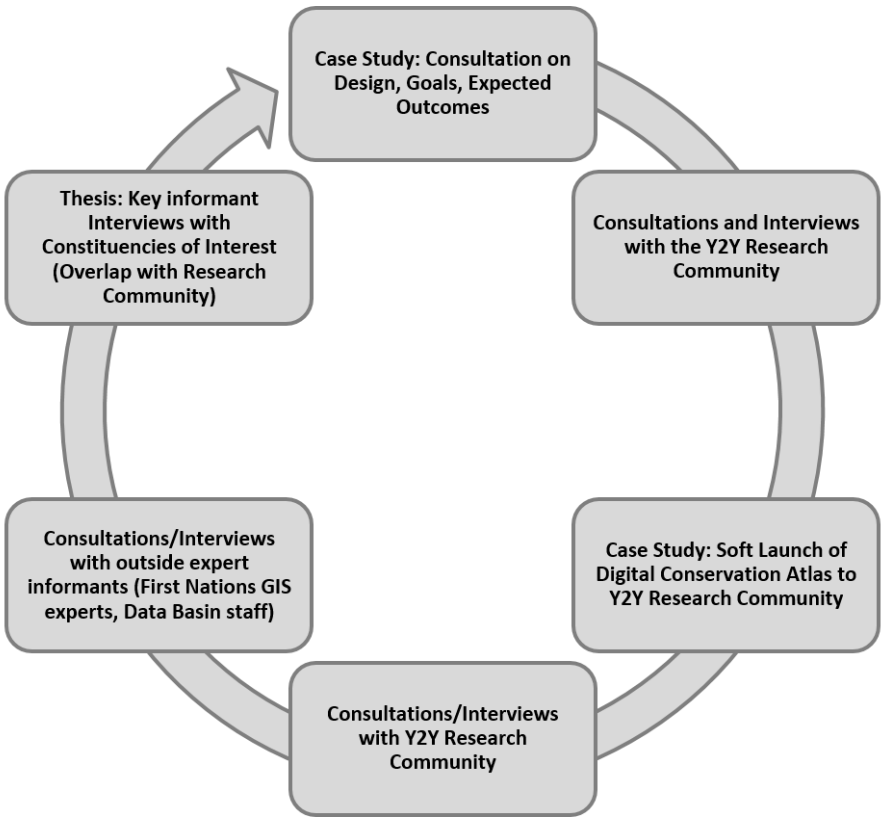

Figure 2. Overview of Methods

As a novice to GIS myself, in learning the technology I sought to combine the skills I developed with the knowledge of the research communities, and examined my own place in the process as the project moved forward. This reflexivity is an important method, and I recorded my own thoughts in a journal to chart my own journey of discovery in this field and examine my ongoing understanding of the potential of these concepts with the applied results.

I used thematic coding facilitated by NVivo 10 to organize and analyze data under descriptive codes and thematic ideas developed both through theory from the literature review (counter-mapping, power of maps) and emergent from interviews (utility of digital atlas, community needs), to explore patterns and ideas connected to the research objectives both deductively, related to the theoretical concepts of critical cartography and counter-mapping, and

inductively to examine themes and theoretical ideas arising from the collected experiences of the data narrative and overall case study project.

3.2. Participatory Action Research

Participatory Action Research (PAR) is research by, with, and for people affected by a particular issue, which takes places in collaboration with academic researchers (Chambers, 1994). This type of action research seeks to democratize the production of knowledge and offer a "politically engaged means of exploring research problems to inform progressive change" (Kindon et al., 2008, p.92). The goal of Participatory Action Research is not just to describe or analyze social reality but to help change it, collaboratively and reflectively (Pain, 2004; Hay, 2000). This change occurs through the active involvement of research participants in the focus and direction of the research itself (Kindon et al., 2008; Kindon, 2009; Hay, 2010).

PAR researchers work with a community engaged in action to explore the practices of communication, knowledge production, and social organization in an attempt to build a framework for progressive action that improves these practices and "to reduce the extent to which participants experience these interactions as irrational, unproductive, unjust or unsatisfying" (Kemmis & MacTaggart, 2005, p.567). In this case, the lack of a transparent, accessible and comprehensive hub for conservation data that can be shared among the research community, and the unproductive and unequal consequences of this deficiency, provided the impetus for action and the need for the Data Basin platform.

Collaboratively, both the researcher and the community partners produce and analyze information, which informs, supports and leads to action and, ultimately, positive political or

social change for those involved (Cameron & Gibson, 2004; Kindon, 2009; Hay, 2010). While PAR is typically employed in the developing world as a tool for academics to positively connect their research with marginalized communities and serve their needs, PAR is a particularly flexible methodology, allowing the researcher to adapt and modify the particular methods to the particular contexts involved (Chambers, 1994).

In this particular case, the research community was defined as those individuals with a dedicated interest in strategic conservation planning in the Peace River Break region of British Columbia, specifically members, staff and researchers associated with the Yellowstone to Yukon Conservation Initiative (Y2Y), the Peace Valley Environmental Association (PVEA) and others who participated in the Y2Y facilitated workshop at UNBC's NRESi in March 2013. There is also a broader community of conservationists who are engaging with GIS and spatial mapping technology exemplified by the Society for Conservation GIS, who may be considered outside expert informants, and the community of the Peace River region at large who can be considered peripheral stakeholders in the project. For the focus of my research however, "community" refers to the researchers, conservationists and campaigners who are acting as the prime movers for the digital atlas case study: conservation advocates including Y2Y staff and contractors, land-use planners including government and First Nations members, and members of the local community of the PRB towns with a specific interest in the project and conservation/land-use in the region. An overview of the PAR process is outlined in Figure 3.

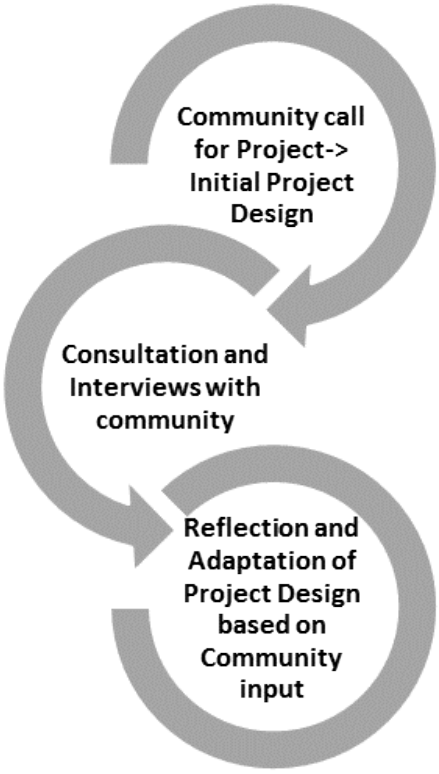

Figure 3. The PAR Process for this research.

Typically the most important characteristic of PAR is its community-driven component: that the design and process are negotiated by all groups involved in the research and carried out in ways appropriate to the context, the time available, and the people involved (Kindon et al., 2007). In this case, the design and process were determined by the community of interest who attended the Y2Y/NRESi meetings, who had endorsed the need for the digital atlas project as set out in the Y2Y vision for the Peace River Break.

PAR generally involves a series of stages through which the researcher and community work together to define, address, and reconsider the issues facing them, requiring a close, cyclical process of reciprocal research and consultation (Kindon et al., 2007; Hay, 2010). The open negotiation of the research design and methodology with the people with whom I worked was critical for the success of the PAR approach (Hay, 2010). I maintained regular (bi-weekly)

contact with the conservation advocate community of interest through several key meetings and teleconferences during the design phase, and continued to consult with them monthly throughout the development of the case-study project and my own data collection to clarify priorities and maintain a common vision and objectives.

Finally, PAR ideally seeks to provide research that can inform and support the community's own goals as related to political or social action. The digital atlas was designed specifically to build capacity for individuals of all three communities of interest to conduct their own analysis of conservation priorities and industry pressures on the landscape. Additionally, my own research into the effectiveness of this tool, its strengths, weaknesses and capability for representing community values and 'speaking back' to government and industry in the region could be of continued value to the community in working towards their goals.

The development of the digital atlas, as a case study, was done in the spirit of PAR. The interviews that provided data for the research component of this tool were an important step in developing the tool itself. The interviews with community of interest members reflected the needs, interests, and perceived utility of the case study digital atlas. However, the design, rollout and use of the tool were primarily completed by myself, the researcher, and so participant observation and self-reflection through journal and notes (rants) was also an important form of data collection. In addition to being the academic researcher, I am also a representative of the ENGO (Y2Y), that called for the development of this tool, and so the lines between community and researcher have been somewhat blurred.

3.2.2 Limitations of Participatory Action Research

PAR can depend on researchers' thoughts and perceptions of the phenomena under investigation, and this introduces the quality of subjectivity of the findings and conclusions (Huesca, 2003). With all qualitative research, the researcher must accept and recognize this subjectivity. While the intention of PAR is to reciprocally engage and develop the participants of the research in the project and social change—the diffusion, or even relocation, of power from the researcher to the community of interest is a central element of the research—that power, position, and values and purpose of the researcher are often still of primacy to the study (Walter, 2009). Within PAR the researcher is expected to be the tool for facilitating change, rather than the owner, director and expert in the research project; the researcher is supposed to have the role of a 'coach' (Whyte, 1991, p.40). The challenge comes when engaging with a diverse community of interest where the research itself is not necessarily a priority, the researcher must take on a larger leadership role than is ideal.

3.3.1 Interviews

For this research, purposive and a limited form of snowball sampling techniques were used to identify interview participants. Purposive sampling can be defined as selecting informants on the basis of the researcher's knowledge of the population, its socio-political elements, and the specific aims of the researcher (Rubin & Babbie, 2005). In this study, participants were selected in consultation with community partners, who helped to identify previous participants of Peace River Break workshops and specific individuals within the regional conservation organizations (Y2Y, PVEA). Snowball sampling is a method for identifying sample participants within a network, whereby those individuals that the researcher was able

to identify through purposive sampling were asked to provide recommendations for other potential interview participants (Neumann, 2003). In this research, additional participants were identified based on recommendations from early interview informants and the community of participants in the case study—those individuals that signed up to use the digital atlas. All participants were provided an information sheet about the research in order to make an informed choice about consenting to participate in the various aspects of this study (Appendix 1).

I conducted 15 interviews approximately 20-45 minutes in length recorded with consent according to the protocols of the UNBC Research Ethics Office. Interviewees represented a broad cross-section of interests and communities, including: First Nations mappers and land-use managers; local community members with an interest in the digital atlas identified through participation in the Y2Y/NRESi workshops; officials within the Ministry of Environment, Forests Lands and Natural Resource Operations, and the B.C. Oil and Gas Commission; conservation advocates involved in direct conservation work within the Peace region and beyond as well as key individuals within Y2Y.

Interview participants were chosen based on recommendations from key advisors within Y2Y, from the participants of the 2013 Peace River Break Conservation workshop, and also drawn from my own municipality and network I developed working on this issues in the region.

While most informants fit within their principal constituency of interest, there was overlap—land-use planners can often be members of the local community, while conservation advocates might have some input in land-use planning. However, as defined above, local

community members are those who have no training or expertise with mapping tools such as GIS, differentiating them from land-use planners. The only conservation advocate that overlapped with the local community was myself, the researcher. In total, 11 groups or organizations were represented, from across five communities within the PRB and two outside of the PRB.

Interview informants can be categorized into three broad constituencies of interest:

Land-use planners: members of government agencies or First Nations involved in strategic land-use planning, resource development, and conservation. These informants are labelled LUP# in interview quotes.

Local community members: people who live in Peace River Break communities, who have an interest in decision-making processes for the landscape, but who have not had any training or experience with mapping or map-making. These informants are labelled LCM# in interview quotes.

Conservation advocates: Other proponents of conservation and protected areas that may or may not live in the Peace River Break region, but have experience using maps for conservation advocacy, science and action. This includes staff of Y2Y involved in this project and in conceptualizing a Living Atlas for the entire Y2Y region. This also includes individuals who had familiarity with Data Basin as a tool, even if they had no immediate interest in the PRB region. These informants are labelled CA# in interview quotes.

Among the constituencies of interest, I interview six land-use planners, four local community members, and five conservation advocates. Eight of the interviewees were men, and seven were women. Four identified as Indigenous or First Nations.

Interviews took place over the course of twelve months; this period of research also represented the growth of the case study digital atlas from concept, to design, implementation and use. Early informants were able to offer key advice and input into how the tool might be used, what data and maps would be useful to them and other interested organizations and individuals, and what likely barriers and opposition might present themselves. As the tool was introduced, informants were able to test its efficacy during the interview process, and offer advice and input on how to improve the digital atlas and whether it would be a useful tool for their work and interests. Informants interviewed towards the end of the research period were able to offer further advice on how the digital atlas might be used in immediate land-use and conservation strategizing and decision-making, and how a broader audience might be reached through outreach and education strategies. This is a critical part of the PAR process, and helped inform the design of the digital atlas and what layers and subjects were included.

These interviews were in-depth and semi-structured; I utilized a list of questions as a general framework but allowed for a more conversational style to develop (Appendix 2). This approach allowed me to elicit information through open-ended questions in order to build a understanding of the interviewee's specific point of view as well as the informant's overall concept of the case study project, what potential it had to meet their specific conservation goals, and how it can be designed to be accessible and foster community engagement (Berry, 1999).

Each interview centered on three key areas: identifying information and data usage needs as pertaining to conservation goals; concerns or conflicts with displaying this information in a web-accessible, online platform for sharing with the general public and/or other stakeholders; and what utility they thought such a platform presented for action. To contribute to data

triangulation, I also used a form of participant observation throughout the process, including my own notes, important discussions via email or phone call regarding the case study, and kept a journal for self-reflection on my research experiences. I used a loose form of thematic analysis, noting quotes and statements that fit within broader themes I identified in the literature review, as well as emergent themes from the interviews themselves.

I transcribed interviews in full and analyzed them by keyword and key concepts using NVivo 10 software. I used NVivo to code and analyze interview transcripts, and compared them with a review of my interview notes and journal. In doing so, I looked for common threads and concepts that emerged from the interviews, such as bias, barriers and need/utility, as well as specific themes from the literature: counter-mapping, and the power of maps.

3.3.2 Limitations of Interviews

The potential for bias is one of the main limitations in the sampling methods used in this research; the constituencies of interest from which interview participants were drawn necessarily produced individuals with specific bias (Neumann, 2003). Additionally, snowball sampling can create bias as initially selected participants recommend other participants with views or interest similar to their own (Stewart & Shamdasani, 1998; Tripp, 2007). Given the intention of the research to gauge the efficacy and utility of the digital atlas case study as a vehicle for counter-mapping practice, this bias is not necessarily negative—individuals with an interest in this tool will have an interest in land-use planning, conservation and mapping—but it must be recognized.

3.3.4 Participant Observation and Informant Interactions

In order to provide understanding of the context and increase the richness of the case study, I utilized a supporting method of data collection and analysis grounded in an adaptation of participant observation. Participant observation is an experiential approach, with data and information generating through experiencing or participating in events (DeWalt & DeWalt, 2010), that can provide "introspection on the part of the researcher with respect to his or her relationship to what is being researched" (Evans, 1988; Phillimore & Goodson, 2004 p.150). My direct involvement as a key participant in the case study project provides both a point of reference for the logic and process of participant observational inquiry and a strategy for gaining access to the thoughts and expectations of the community with regard to the project and its potential, which would be less available from the standpoint of a nonparticipant (Jorgensen 1989).

The collaborative and reciprocal nature of the case study and close relationship with the community in its development and design led me to recognize that my interactions with key informants and partners in this community were valuable for data generation and enhanced understanding and analysis. I have incorporated these interactions into this study using methods of participant observation. I have included these interactions, which include notes from meetings, electronic communications—inclusive of email as well as collaborative conversations on the digital atlas project's web-forums—and phone conversations. This data supports the context and frame of reference of interview data, as well as enriching the research as a key component of the case study.

Throughout the interactions, I included careful notation and reporting on the choices made to include particular data, what the specific circumstances and context of their inclusion are, and how they are recorded. I kept a field notebook specifically for capturing this information in a single source with notes as to the context and frame of reference (DeWalt & DeWalt, 2010). This information was entered and coded in NVIVO as 'Key Informant Interactions' along with my field journal notes in order to distinguish it from other data sources such as interviews.

As the successful use of participant observation "supposes that the researcher is able to assess the impact of his or her own viewpoint on the collection of data, analysis and the written product" (DeWalt & DeWalt, 2010, p.111) maintaining a separate research journal for self-reflection is also a critical piece of this data. This journal was separate from the field notebook for capturing informant interactions and notes, and was maintained solely to provide insight into my own point of view and my assessment of the likely impact of the kinds of data I collected and my approach to analysis, and support reflexivity.

3.3.6 Limitations of Participant Observation

Observation is filtered through one's interpretive frames and that "the most accurate observations are shaped by formative theoretical frameworks and scrupulous attention to detail" (Schensul, Schensul, & LeCompte, 1999, p.95). In a more traditional Participant Observation method, the ideal role of the researcher is that of the observer as participant, so that the researcher's observation activities are known to the group being studied, yet the emphasis for the researcher is on collecting data, rather than participating in the activity being

observed (Gold, 1958). For this study, the researcher was both an observant and participant, given the role of developing the digital atlas case study.

3.3.7 Reflexivity

I have established the importance of reflexivity in conducting participatory action research and as a critical component of the adapted participant observation method I chose to add to my research case study and interviews. Reflexivity is widely acknowledged as a critical component of social science research, as the recognition that the interpretation of data is itself a reflexive exercise "where meanings are made rather than found," from the particular position of the researcher (Mauthner & Doucet 2003; Mauthner et al. 1998, p.742).

I believe that I had a unique position as a researcher in this project, in that I was a member of all three 'communities' I have identified as being involved with this project; the community of researchers, conservationists and individuals associated with Y2Y and the PVEA, scholars practicing mapping for conservation generally, and, as I lived in Chetwynd in the Peace region from 2014-2018, the local area community as well. As part of these communities, I have attempted to write selectively about the potential I saw and discoveries I made in the design of the case study project, recognizing that I speak from a position of both insider and outsider. This use of personal experience supplemental to my research interviews and participant observation with key informants has helped to illustrate facets of community experience, allowing me to enrich the narrative and "make characteristics of a culture familiar for insiders and outsiders" (Ellis et al., 2011 p.3).

I kept a research journal for the purpose of recognizing my situation in reference to the research and case study project, which is distinct from my fieldwork notebook and project

notebook. This journal included my own thoughts with regard to positionality to the study communities, the technology and potentials, and my own experience in learning and practicing mapping for conservation design in a geographic information system.

The goal of this reflexive narrative was not only to acknowledge my own place in the research, but to provide an expressive account of my personal and interpersonal experience in the design and introduction of the case study project. By incorporating this narrative into a holistic analysis of "patterns of cultural experience evidenced by field notes, interviews, and/or artifacts, and then describing these patterns using facets of storytelling, showing and telling, and alterations of authorial voice" (Ellis et al., 2011 p.3), I attempted to present a comprehensive report of research findings and recommendations that is engaging, accessible and transparent.

As part of the journal writing process, I consolidated my notes into short reports on insights, concepts, frustrations and barriers I encountered while developing the digital atlas case study. These entries offered both a reflexive snapshot of my thoughts and insight at specific points in time during the development of the digital atlas case study tool, as well as broader themes I have been examining throughout the research process. This form of reflexive narrative allowed me to utilize my own experiences in grappling with issues and concepts related to the digital atlas case study to make a point about the importance of particular events, processes or experiences (Behrens & Laurence et al., 2007). They allowed me to express how I was examining the subject and how I perceived and engaged with specific challenges, opportunities, and thematic concepts such as counter-mapping as the research unfolded. This allowed me to acknowledge and describe my role and my own experiences in the research process, and how the choices of concepts I found particularly interesting, relevant, and/or

engaging potentially shaped the outcome of my research (Giltrow, 2005, p. 209). These entries were coded in NVivo and select quotes from them are used in the narrative portion of this research when appropriate.

3.4 Data Management and Privacy

As part of the Informed Consent procedure in keeping with UNBC Research Office ethics standards, interview participants were asked if they would like to receive a copy of their interview transcript for verification and their own records. All interview participants were provided an information sheet about the research in order to make an informed choice about consenting to participate.

No names or identifying information were included in the dissemination of the interview results. Code numbers were used on the interview records to protect participant's identity, as identified above. Emails and other interactions from the research community were likewise kept confidential.

3.5 Data Analysis

The purpose of the research being undertaken has an immediate and direct effect on the direction the analysis of qualitative results takes (Punch, 2013). Using the NVivo 10 research tool, data gathered from interviews, participant observation, and reflexive narratives was examined, coded thematically and categorized in specific themes emergent from the literature and the interviews themselves, and then interpreted in relation to the research questions. Coding was composed of three broader themes or categories chosen both as their connection to my research questions and what I know to be emergent from the text of interviews, notes and my journal. For the purpose of this study, interpretation of data was focused on linking

key phrases, concepts, and ideas raised in the data to one another through coding in NVivo. These codes fit into four broad thematic categories, under which were nested specific codes available in Appendix 3. The first theme was *accessibility*; the ability of users to access and easily view maps and mappable data for their own interest on the land-base. This includes barriers to getting the data or visualizing the mappings to suit the user's needs, as well as issues of privacy and sensitivity of certain data that may or may not be problematic to present publically.

The second theme was *data usage and needs*, and specifically points to what information the interviewed communities would find useful and desirable in an online atlas. Mentions of resource development or specific geographic features could have an interesting relationship with the availability or unavailability of data and the power of mapmaking.

The third thematic category was *community*, and refers to the needs of local communities', individuals' or groups' participation and interest in digital atlas or other mapping tools.

The final broader thematic category is tied more to the theoretical framework of my research questions, *map theory,* with terms dealing with the power of maps and maps as political tools and objects with inherent biases and included mentions or relation to counter mapping.

Conclusions from these relationships can be drawn and inferred as they relate to common themes and issues revealed in the text. These conclusions and relationships were developed into a system of broad concepts and themes that can be linked to relevant theories raised in the literature review (Guest et al., 2012). The structure of this system is explained in detail in the introductory chapter of the narrative, section 5.1.

3.5.1 Limitations of Data Analysis

Data analysis can be affected when concepts and relationships identified in the data are extended to complex theories, such as counter-mapping (Punch, 2013). Bias can commonly be developed in research when the researcher's favoured outcome informs the creation of categories and themes of analysis, but in this case as the project was rooted in PAR, this bias was acknowledged from the outset: conservation of the PRB region was a goal of the case study. Utilizing a fixed system of parameters and rules for categorization and coding can reduce the amount of subjectivity in categories and relationships (Tripp, 2007; Holsti, 1969). In this case, I built a categorization system based on specific words and phrases matching written descriptors of each category (Appendix 3).

4.0 Development of the Case Study – How the Digital Atlas Worked

The Y2Y/NRESi PRB workshops identified the need for an effective way to house and make accessible research and map data for the PRB; a data hub that would provide easy access to spatial datasets so that partners could engage in conservation mapping and prioritizing across geographies (NRESi, 2013, p.23). An overview of the case study developed as a result of this need is described in section 3.1.

GIS technologies are a powerful analytical tool with demonstrated efficacy in solving complex conservation problems, and the price of these tools has steadily declined while the capabilities and features have improved. The greatest financial expenses of this technology over the last 20 years have been found in the creation of spatial data, with the greatest costs coming from the building and maintaining high-resolution data sets, which tend to be the most valuable and useful for conservation work (Longley, 2005). Data collection is potentially one of the most expensive and challenging GIS activities, with many diverse sources (Longley, 2005). In addition, "training, funding, and data issues appear to be the most significant barriers preventing greater use of GIS for planning purposes" (Göçmen and Ventura, 2010). These costs can be prohibitive to smaller government agencies, First Nations, community groups or local government, even where these groups have a greater need for mapping data and capacity for critical land-use planning and decision making. Significant time and financial costs associated with identifying and acquiring spatial data, and sorting through existing datasets to identify what information is needed, are significant. The sourcing and acquisition of data is one of the main challenges facing GIS practitioners, especially in the non-profit or at community level (Eglene & Dawes 1998, Göçmen and Ventura, 2010).

A new model of collaborative mapping, with a vision of empowering grassroots communities and interest groups, will need to recognize the financial and labour barriers facing these communities, and focus on:

> "cataloging existing spatial data sets and devising an online space where potential users could easily contact and negotiate with the data custodians to re-use those data; where costly but highly beneficial projects to develop new spatial data resources would be undertaken by groups of organizations working together to create a shared asset; where GIS practitioners could readily share their problems, questions, and experiences with one another; and where GIS analyses of many kinds would contribute to improved environmental management, health care, social policy, education, land use planning and commerce." (Eglene & Dawes, 1998 p.1).

While leaps in data storage have been made since the turn of the 21st century, many of these problems persist, especially for low-income or resource communities.

Early in the developmental stage of this project I met with the Y2Y proponents at the 2013 BC Protected Areas Research Forum and discussed options for a platform for the Digital Conservation Atlas. Options discussed included a standalone website with simple storage for mapping data and finished map products, and a display tool based on Google Maps. The most obvious candidate for this tool, however, was identified as Data Basin.org. Data Basin is partially funded by the Wilburforce Foundation, a key supporter of Y2Y and many other conservation organizations throughout North America. In addition, Data Basin was chosen to house an upcoming Y2Y Living Atlas, which would offer conservation maps and spatial data across the Y2Y region for local partners to support conservation advocacy.

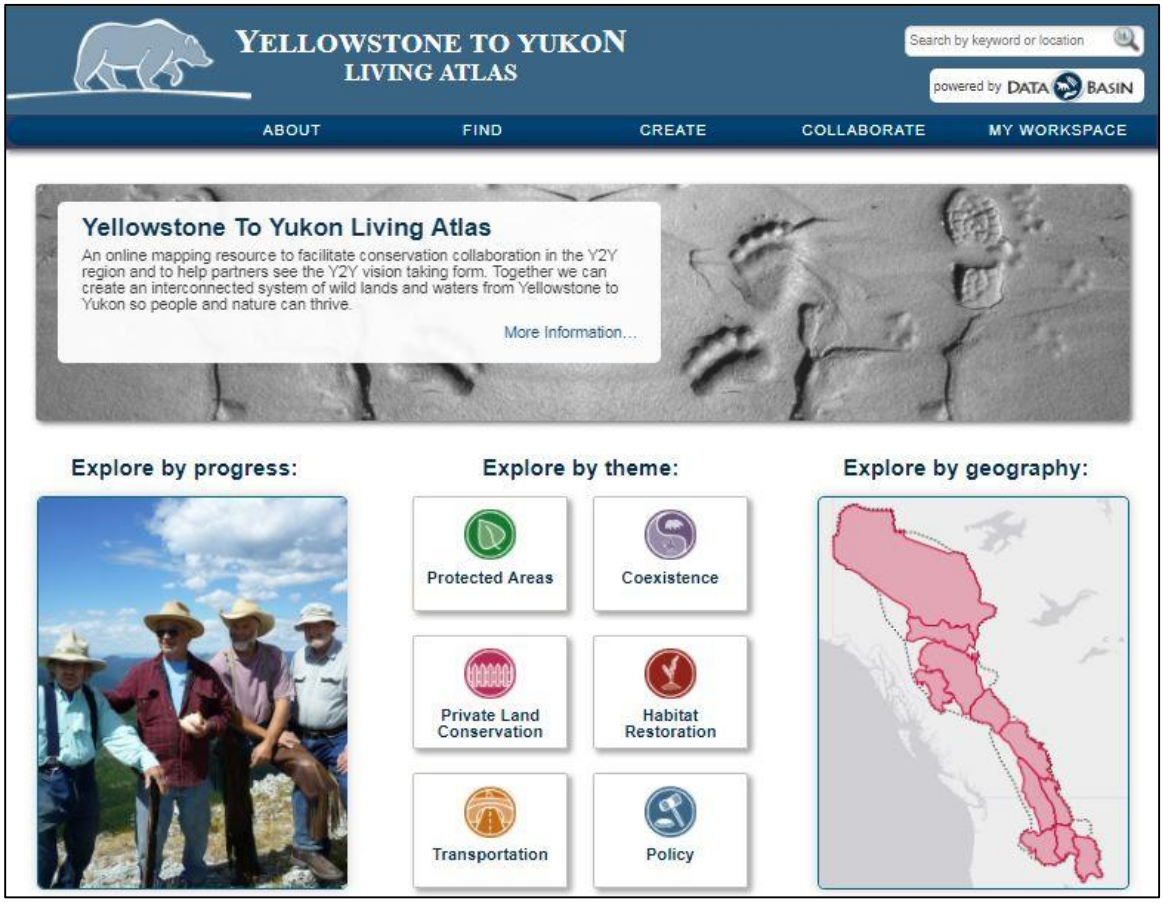

Figure 4. The welcome page of Y2Y's 'Living Atlas', a collection of datasets and maps across the Yellowstone to Yukon region. The PRB digital atlas would be 'nested' within this site. Reprinted with permission from https://y2y.databasin.org/, 2013, Retrieved 2014. Copyright 2018 Conservation Biology Institute.

The Peace River Break digital atlas fits well into this larger Y2Y atlas, and Data Basin already provided much of the utility and functionality that proponents requested cited as critical to the project. Data Basin was developed to expand "individual and collective ability to develop sustainable solutions by empowering more people through access to spatial data, non-technical tools, and collaborative networks" (About Data Basin, 2017). This provided an ideal starting point for the PRB work.

Once Data Basin was selected as the platform and the PRB digital atlas was created, the next step was in collecting and uploading the relevant spatial data and maps that would populate

the tool. For the purposes of this project, the focus was on data acquisition from existing sources, rather than developing new datasets through surveying or satellite imagery, which would be too costly in time and financial considerations. It was determined that Y2Y would provide any new datasets developed as part of other research contracts to continue populating the digital atlas in the future. The case study research community behind this project had already identified, produced and/or utilized some key datasets, while some basic data was readily available from UNBC and the online data warehouse with the BC government. Furthermore, the research community provided me with some general direction in what types of datasets to search for to populate the tool.

There are many widely distributed sources of geographic information, with catalogues that cover the Peace region held by governments, First Nations and universities, and specific conservation data held by conservation organizations, including Y2Y. GIS data can be jealously guarded by organizations and individuals, and many of the datasets identified by the research community would require negotiation with its custodians for use in public display. This is fairly typical, as GIS "technology requires two-way relationships between technology and people. GIS technology, like any other technology, is more than a tool; it connects different social groups in the construction of new localized social arrangements" (Harvey & Chrisman, 1998, p.1). Over the course of the development of the digital atlas tool for the research community, building social relationships that engendered trust between myself, UNBC/Y2Y and individuals or organizations that held needed datasets would become a critical part of the project. According to a framework developed by at a 2002 conference on GIS and Developing Countries (GISDECO),

> "the main components to understanding spatial data sharing behaviour are the intention construct, i.e. the willingness to engage in spatial data sharing activities across organisational boundaries which is made up of the attitude towards spatial data sharing; the social pressure to engage, or not to engage, in spatial data sharing; and the perceived control over spatial data sharing activities that key individuals within organisations perceive." (Wehn de Montalvo, 2002, p.3).

In the case of the PRB digital atlas project, the degree to which this negotiation and social arrangements were challenges or outright barriers depended on the source of the data. For the purposes of the case study, sources of spatial datasets can be grouped into five broad categories:

- Open-source, free and online. This includes data from DataBC
- Restricted, free and online: Available, but not accessible without permission.
- Custodians: Available after discovering custodians and getting permission (NCC, DSF)
- Not Available: GIS data format not readily available
- First Nations

Each of these types are described below.

Open source, free and online: This category refers to datasets that were available for immediate download online without cost. Much of the baseline data available on the BC government's DataBC web portal falls within this category. This includes 1555 datasets under the open government license (OGL), which allows the public to "copy, modify, publish, translate, adapt, distribute or otherwise use the Information in any medium, mode or format

for any lawful purpose" so long as the source of the information is acknowledged through an attribution statement ("Open Government License", 2011). Data BC and the OGL are forward-looking policies when compared with the realities of many other jurisdictions worldwide, and provide a straightforward process to retrieve datasets from the BC government. Open Data has not been a universally adopted principle in Canada, "in spite of the obvious benefits in terms of efficiency and effectiveness to be derived from sharing geographic information both within and between organizations, the idea continues to be resisted, leading to inefficiencies from duplication of data collection and storage" (Nedović-Budić & Pinto, 2000, p.455). Other jurisdictions provide open data, including some federal government datasets, as well as municipalities and regional districts. Additionally, some datasets were available from ENGOs such as Global Forest Watch, which maintains a warehouse of GIS data, including global modelling of intact forest landscapes.

Restricted, free and online: This category refers to datasets that were available for download online without cost but required a more onerous application process to request permission for the information. This is a more typical approach to data sharing among governments, considered a top down strategy which provides a single source for government data that "seems to satisfy a [government] office's interest...they have only one system for which they must provide advice and technical support, they fulfill their mandate and they provide a solution that will work for at least some of the intended clients.' (Shackley & Wynne, 1995, p. 117). At the same time, governments are able to control sensitive, or potentially sensitive, information.

Custodians: This category refers to datasets that were only made available after identifying personnel at the source who have custodianship over the data. Individual organizations and

corporations usually have their own data management policies and practices, which impact the ease in acquiring datasets. The process may include standardized application forms, but they are not part of an online automated web portal. Identifying and acquiring datasets in this category usually involves identifying the correct custodian and then a direct conversation or negotiation with them. This data tended to be held by industry or conservation ENGOs.

Not available: Some datasets identified as priorities by the research community were simply not available. This includes information that could not be identified, data that are restricted and off-limits to the public—which includes the bulk of private industry data—as well as datasets that individual custodians have refused to provide access to, based on a variety of factors or concerns.

First Nations datasets: This is included as a separate category to refer to datasets held by First Nations and affiliated organizations. Identifying and acquiring datasets from First Nations was a sensitive process, which involved more than a simple online query or request. Datasets were usually made available after a relationship with key leaders and land-use managers was developed. First Nations in the PRB tend to have dedicated GIS managers or departments, and specific data management practices. Datasets in this category had specific restrictions on use and display to protect sensitive or significant information.

In the development stage of the digital atlas, the research community identified 41 datasets that were a priority for the tool (Table 1). Once these datasets were collected from the sources

listed above, I used ArcGIS to clip[3] each to a boundary developed in consultation with the research community. This boundary was initially simply the Y2Y Peace River Break Priority Area boundary, but was expanded to the outer edge of adjacent watersheds to provide a more geographically and ecologically sound study area and allow for better examination of large-landscape habitat and conservation values and opportunities. Identifying, collecting, and preparing these datasets was an ongoing process, but the initial tranche of 41 datasets was completed over a five month period. Once collected, each dataset had to be prepared for upload to Data Basin, which limits uploads to Esri Shapefiles, File Geodatabases, or ArcGRID formats inside a layer package file (.lpk). A layer package, created in ArcMap, includes both the layer properties (the mechanism used to display geographic datasets visually—each layer references a dataset and specifies how that dataset is portrayed using symbols and text labels) and the dataset referenced by the layer (the data behind the visualization). With a layer package, a user can save and share all aspects of the layer—its symbolization, labeling, field properties, and the data. This allows other users to add a layer package directly into their maps without having to know how to access the database or classify the data (Esri, 2015).

[3] In ArcGIS, to clip is to overlay a polygon on one or more target features (layers) and extract from the target feature (or features) only the target feature data that lies within the area outlined by the clip polygon. In other words, the boundaries of the second polygon are imposed on the first polygon (Dale, 2005)

Table 1. Initial Datasets Identified by Research Community

Layer Feature	**Access**	**Data Category**
Roads	BC Government	Open-source, free and online
Watersheds	BC Government	Open-source, free and online
Forest Cutblocks	BC Government	Open-source, free and online
Power Lines	BC Hydro	Open-source, free and online
Oil and Gas Tenure	BC Government	Open-source, free and online
Mineral Tenure	BC Government	Open-source, free and online
Parks and Prot. Areas	BC Government	Open-source, free and online
BEC Zones	BC Government	Open-source, free and online
Well Sites and Pads	Oil & Gas Commission	Open-source, free and online
Facilities	BC Government	Open-source, free and online
Air Strips	BC Government	Open-source, free and online
Trails	Global Forest Watch	Custodians
Coal Licenses	BC Government	Restricted, free and online
ALR	BC Government	Open-source, free and online
Wetland Program	BC Government	Open-source, free and online
Burn Program	BC Government	Open-source, free and online
Ungulate Winter Ranges	BC Government	Open-source, free and online
Motor Vehicle Prohibition	BC Government	Open-source, free and online
Intact Forest Landscapes	Global Forest Watch	Custodians
Combined Human Access	Global Forest Watch	Custodians
Fish Observations	Gov	Open-source, free and online
Petroleum Roads	Oil and Gas Commission	Restricted, free and online
Forest Roads	BC Government	Open-source, free and online
Land Use Plans	BC Government	Open-source, free and online
Geology	BC Government	Open-source, free and online
Soils	BC Government	Open-source, free and online
Ecological Drainage Units	BC Government	Open-source, free and online
Vegetation Inventory	BC Government	Open-source, free and online
Species at Risk	BC Government	Open-source, free and online
Warm/Hot Springs	BC Government	Open-source, free and online
Pipelines	Oil and Gas Commission	Restricted, free and online
Elevation/TRIM	Government of Canada	Open-source, free and online
Traplines	First Nations	Unavailable
Gravel Pits	BC Government	Open-source, free and online
Grazing Tenures	BC Government	Open-source, free and online
Guides/Outfitters	Unsourced	Unavailable
Ecosections	Gov	Open-source, free and online

Strength of Conservation	Nature Conservancy Canada	Custodians
Management Objectives	Nature Conservancy Canada	Custodians
Conservation Blueprints	Nature Conservancy Canada	Custodians

Uploading a layer package to Data Basin is a straightforward process, but the platform does require the user to enter information into fields crediting the dataset's source, a description of the dataset, and 'tags'—keywords pertaining to the dataset—as well as optional fields for a direct download link to the original source, a citation for the dataset or any peer-reviewed publications, and contact information for both the user and organization. Data Basin has a rigorous data import process that is handled through administrative approval and Data Basin requires all spatial data (biological, physical, and socio-economic) uploaded to its libraries to be well-documented through metadata (Comendant et al., 2013). This is important in maintaining legitimacy and scientific rigour and trust in Data Basin's data. If valid metadata are found with the upload, it is used to help populate these steps. GIS metadata can be described as:

> "Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data were collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data)" (Kapetsky & Aguilar-Manjarrez, 2007, p.112).

Data Basin requires the user to enter metadata manually for each layer within the layer package, a tedious and time-consuming process, which for some datasets included research to

determine missing metadata fields. This rigorous standard ensures that all critical information, including citations and sources, are included in every dataset uploaded to Data Basin.

As outlined in section 3.1: Case Study, Data Basin provides controls for the use and display of sensitive or proprietary datasets as well: “Data Basin encourages sharing and publishing, but also provides privacy and security for sensitive information when needed” (Comendant et al., 2009, p.1). Until I completed interviews and populated the digital atlas with 41 datasets, the atlas was locked to the public and only available through invitation (Figure 5).

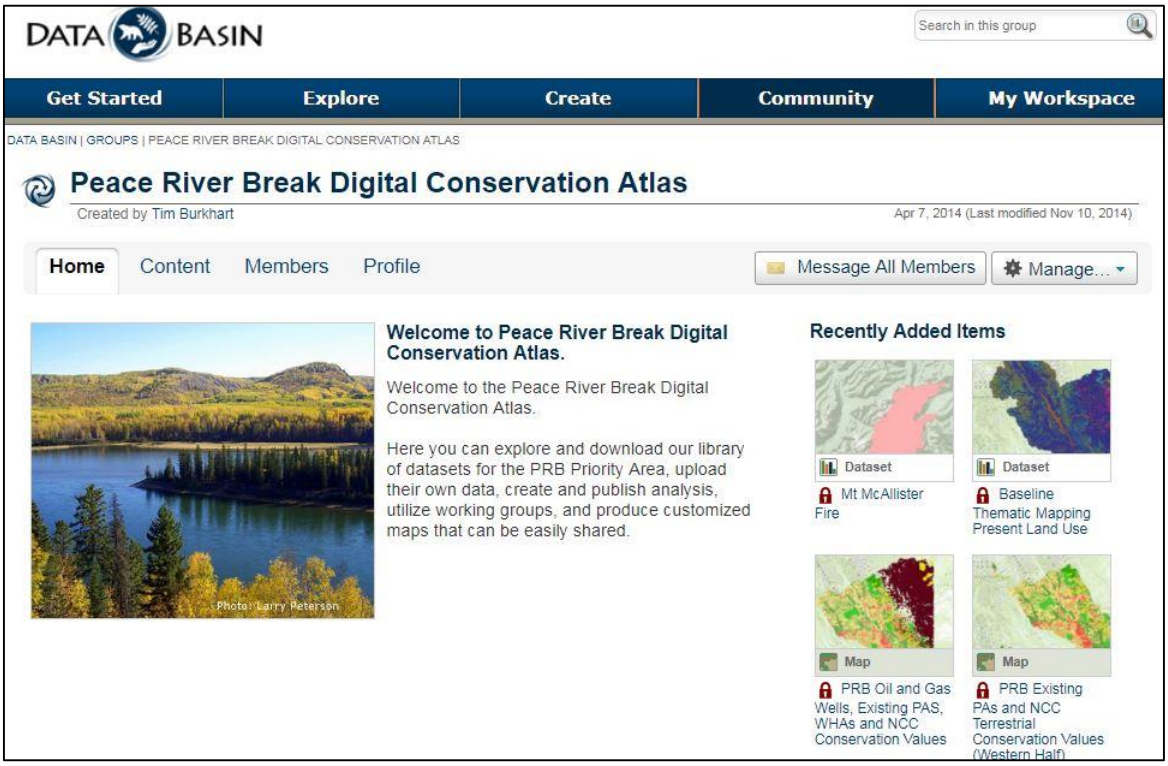

Figure 5: The front page of the PRB Digital Conservation Atlas, captured in 2014. You can see recently added datasets on the right hand side. Retrieved from: https://databasin.org/groups/49043197f4a44333bff8cfcc8935666f Copyright 2018 Conservation Biology Institute. Reprinted with permission.

Making invitations to individuals within the research community was the first step in outreach to bring users to the digital atlas. As the Data Basin group was populated with datasets, expanding this user base became a priority. In consultation with the research community, a wider set of potential users was identified. This included all attendees of the Y2Y/NRESi PRB workshops as well as individuals in the PRB and beyond with a specific interest in regional conservation. I produced a newsletter (Appendix 4) and UNBC blog/website to help outline Data Basin, the PRB digital atlas and its intended usefulness, and contacted this group of individuals.

The next tranche of outreach was done through local and regional media. I crafted a press release in conjunction with UNBC Communications, which was picked up by newspapers

including the Prince George Citizen, Alaska Highway News, Energeticcity.ca, and My Prince George Now (Appendix 5). I was also interviewed on CBC Radio 1's Daybreak North about the project and research.

A total of 14 users signed up to use the digital atlas, who can be described in 4 broad categories:

- The Research Community
- Government Analysts
- Other Conservationists
- Academics

Note these individuals are not necessarily the same as those I identified as interviewees, though there was some overlap. Individuals in the research community who were the impetus behind this project signed up and were the most active users of the digital atlas, as expected. Government Analysts, from different ministries and agencies, signed up as well but did not make maps or galleries within the Data Basin atlas, rather downloading datasets directly for their own use. Other conservationists from ENGOs not participating in the Y2Y/NRESi PRB workshops also signed up, and have used datasets and maps on both the group and in their own galleries/groups on other Data Basin atlases. Academic researchers from the UNBC community have also used the datasets, but not the Data Basin maps/galleries, for use in classes such as ORTM 400 Conservation Area Design and Management.

Perhaps unsurprisingly, the most prolific users of the Data Basin tool were the research community, and myself as both a researcher and as PRB Coordinator for Y2Y. I consciously used the tool early on in my position, using Data Basin to overlay layers and make maps. In

my journal, I acknowledge the usefulness of Data Basin as a map-making tool when I did not have ArcMap available. The research community utilized the digital atlas as intended, building maps and overlays that examined all levels of existing protection in the PRB in order to develop advocacy and research material in aid of conservation. It was used to identify gaps, and assess the connectivity values of the Peace River, the impacts of the Site C dam and other major developments, assess connectivity and mitigation opportunities at a fine scale in the landscape, wildlife mortality hotspots along regional highways.

The full development of the Data Basin PRB digital atlas took five months, the bulk of which was data identification, collection and preparation. Proving the utility and need for the PRB digital atlas beyond the initial research community and a handful of interested parties was the greatest challenge in the case study, and one which provided revealing information on the barriers, pitfalls and power of digital mapping tools for grassroots communities.

5.0 Discussion and Interpretation of Findings

In this chapter I provide a description of the themes and concepts that emerged from in-depth interviews and participant observation that were conducted with 15 individuals in the Peace region over the course of 2014 and 2015. In addition, I include entries from my own participant observation experience in developing the case study digital atlas tool and engaging with mapping work as a form of participatory action research, to support conservation in the Peace region.

Given the qualitative approach of this research, this chapter will serve as both a description and interpretation of the interviews and other evidence of the findings of the participant observation and participatory action research. I provide a comprehensive description of my experience developing the case study digital atlas, the concepts and themes that members of the communities of interest grapple with in engaging with mapping and land-use in the region, and give deeper insight into land-use planning at various levels of community. The purpose of this chapter is to examine my findings in detail and build a narrative around specific themes common in the counter-mapping literature as relates back to the theory outlined in my literature review, and emergent from the participatory action research and case study.

I start by examining how mapping in this region is used by industry and government to tell a specific story to the public, and how the research community has deconstructed these narratives. This will be followed by explicit discussion of counter-mapping, the utility of a digital atlas tool as both an answer to and continuation of the barriers to engaging in counter-mapping, and finally a description and interpretation of how the community could utilize a digital atlas to 'speak-back' to power through maps that reflect the values important to them.

5.1 Maps Give Their Audience the Lie of the Land, on Behalf of Who Tells the Lie

Maps do not inherently lie, but they can be misleading, and they can be used to tell lies and help to mould the agenda of their creators, as much by what is omitted as by what is included. Trust in the accuracy and truthfulness of maps is built through consistency, accuracy, transparency and community involvement. This section discusses the use of maps in telling a story that fits an agenda, and how counter-mapping through a digital atlas tool can be employed to not only refute that agenda, but build trust for a mapper and organizations in the long run.

The misleading qualities of maps can be relatively benign or unintentional; a map that reflects the inherent bias of its maker or in some cases simple incompetence. But maps are also used to intentionally mislead their audiences to suit an agenda. The "Route Safety" animation videos for the proposed Enbridge Northern Gateway pipeline in Northern B.C. provided an excellent example. Enbridge developed a video showcasing some fly-over imagery of the proposed route for their pipeline across Northern B.C. The glaring issue with this imagery appears when the video flies over the route from the coast to the open ocean through Douglas Channel, the map imagery appears to adopt a much coarser scale and the islands that dot the coast in the channel, totalling approximately 1,000 km^2, have been 'conveniently' omitted. This serves to make the audience believe the route is far more open, and therefore safer for supertanker export ships than it might otherwise appear, and misrepresents the complexity of the coastal topography. The company produced this video explicitly to show how the proposed route was a safe one for the environment.

Image screen captured from Route Flyover Ad at duration point 0:39:

Image above adjusted to include representations of the islands that lie within the waterway (islands added by Lori Waters)

Figure 6**.** Enbridge Northern Gateway Flyover and Counter-map showing how omission of features can suit a narrative. By Lori Waters, 2012. Retrieved from: https://www.wcel.org/blog/douglas-channel-islands-enbridge-erases-lori-waters-replaces

This resulted in a serious backlash from opponents to the project. One such opponent, Lori Waters, practiced counter-mapping and produced many new maps and 3D renderings to highlight the issue (Figure 6).

According to Waters,

> "the removal of the islands by Enbridge was particularly important because the animations were presented on Enbridge's primary website where members of the public could be expected to go for information on the proposed project, and because the majority of visitors to the site would likely have the expectation that the information that Enbridge was presenting on the site would be correct information. However, it was clear from Enbridge's videos and their disclaimers that instead, grossly inaccurate information was being presented to the public on the primary website which purported to provide project information. And, as shown by the images that I created, in order to create their animation, Enbridge would have had to deliberately and grossly manipulate the geographical model used in order to render Douglas Channel as essentially devoid of islands." (Waters, 2016).

This is a case of a proponent using a map display as a public relations/advocacy document, with the stated intent of showcasing how safe the proposed pipeline and tanker route was to assuage fears of environmental damage. The counter-mapping practice of Lori Waters and others was one piece in a long battle between the company and its opponents on this project. Enbridge lost credibility among the public, its politics laid bare; opponents were given an opportunity to show how the company was being deliberately misleading, and this no doubt damaged public trust, calling into question other assertions as to the safety and environmental protections made by the company.

This type of misinformation by map came up several times in the research. Conservationists who had worked with mapping had come across instances of interest groups or industry producing intentionally misleading maps to suit their agenda. In total, there were 13 mentions of 'misleading maps' by six interview informants; three mentions among land-use planners, one by local community members, and two by conservation advocates. This includes examples not only specific to the PRB region.

One such instance was explained by an informant discussing maps made by offroad vehicle users to promote their claims to use of the land:

> *"Maps can be misleading. And I can't think…but I know I've seen some maps that are misleading. Like the ORV maps in Idaho. Off-road vehicle. Because they're really big in southern Idaho and they've created a bunch of maps which are basically lies. You know showing that there is roads where there are no roads. Because if they're showing that then their map is incorrect and our map is correct.* (CA 2)

The difficulty faced by organizations or individuals that misuse maps for this type of purpose is that they may face backlash from opponents when caught out in the lie. While the science of cartography can also make this type of agenda permissible, an outright disingenuous use of maps also calls into question the authority and accuracy of other products attributed to that organisation or individual. It is critical, then, that biases are recognized up front and that the temptation to create a map that suits an agenda is resisted in favour of precision, which enhances the credibility of other maps. The conservation advocate continued:

> *"One of the things we always held as our first principles [was] always tell the truth. If you always tell the truth then you can't be questioned. I think conservationists for the most part…they told the truth. You know I think that's one thing on our side; it is difficult to fault conservationists for not telling the truth, unless you know some other instances, and I know there probably are, but for the most part they're right on...it's not a good pattern to not tell the truth."* (CA 2)

It is not always easy to tell when a misleading map is intentionally untruthful, or if the bias is simply ingrained in the cartography. In some cases, the mapmaking was not done in deliberately misleading manner, however, choices made by mapmakers on what to display and what to omit raise questions about the accuracy of the information presented. BC Hydro has conducted extensive mapping of the Peace River Valley in the run up to the Site C dam project. Some of these maps elicited a suspicious response from informants, who have argued that some of the boundaries and notations on these maps are less than accurate:

> *"Well, yeah. Let's see. [LAUGH] They seem to have trouble with the boundaries of [land] titles. So you've got to be careful with BC Hydro's mapping sometimes on land ownership. Because there's examples just here on our place where they were showing some of our land as crown land or BC Hydro land."* (LCM 1)

In this case, the proponent is using maps to tell a story, whether intentionally or not, and local community members immediately raised a red flag in analyzing the map.

> *"In a more recent document, they were missing half of them [land features and titles], not half of them, but missing some of them. So they have a real problem with keeping the handle on mapping in the valley I think. When they show the overlay of the reservoir on the valley. That's a snap shot of the instant that is flooded, but of course that's all going to change, and their impact lines run all over the places where things are going change. How they come up with those lines…I don't know how they do that."* (LCM 1)

These same informants felt that the biases towards the project's approval, costs, and impacts inherent to the proponent (BC Hydro) were evident on some of the maps they produced. It is also important to note that the maps being discussed were produced for public consumption as part of the project consultation process, and so were likely designed with that audience in mind. Maps produced by a consulting firm employed by BC Hydro to conduct scientific environmental assessments in the valley were given more trust by these informants, as they were seen as having less of an agenda in promoting the project one way or another.

> *"So when you come to the mapping, [look] through the accuracy of Hydro's information. When it comes to what BC Hydro puts out—it's always questionable, but when it comes to what Keystone has done, and their data, I would say from what we can see, it's accurate.*
>
> *Because they've had people on the ground, they've been studying, they've been following them. And the data is [accurate]. And they're professionals. They're doing their job."* (LCM 1)

The fact that the informants had seen the consultants on the ground gave them more credibility as having a better concept of the land and territory itself, and while the BC Hydro proponents are also professionals doing their job, the perception of pushing an agenda left informants questioning whether or not to trust the accuracy of their maps. When inaccuracies were discovered in land title or the location of impact lines, the veracity of *all* their maps came into question. Whether this was the result of a brazen attempt at misleading the

audiences of the maps, as is suspected to be the case with the missing islands in the maps produced by Enbridge, is questionable.

Maps that are misleading even when that is not the intent can have the same effect on the audience; distrust of the organization itself, and of all mapping products that come from that organization. A conservation advocate informant who negotiated with a government Forest Service felt that the reputation of the agency suffered greatly when a string of what he believed to be inaccurate maps were produced in the past. These inaccuracies caused considerable consternation on the part of the conservation community, requiring the conservation advocate to spend the time, money and effort to refute these maps with ground-truthing and counter-mapping of their own.

> *"That's why the Forest Service got such a bad reputation back in the eighties and early nineties, because we proved [that] some of their maps were wrong. And it calls into question every one of their maps, once you say part of this map is wrong. Then the rest of the map can be questioned also without doing the ground-truthing. They really have got a lot better because we call them on their shit."* (CA 2)

According to the informant, the counter-mapping carried out by the grassroots conservation community strengthened the accuracy of the maps of the Forest Service agency, and ultimately helped restore their reputation as a fair dealer when it comes to land use. When asked, the informant stated that he believes the agency was not being intentionally misleading, just sloppy.

> *"I don't know. I have a lot of friends that worked for Forest Service and I don't think [it was intentionally misleading] no. It was just budgetary problems. They were just doing some guessing and hoping nobody noticed." (CA 2)*

Many of the same barriers to producing accurate, quality maps existed for the Forest Service agency in this case, and resulted in a negative perception of the agency and the mapping products it produced. Through counter-mapping, this perception was redressed. Counter-

mapping can also redress inconsistencies or instances where the scope of an industry, government or other proponent's mapping was incomplete, insufficient, or inaccurate. Land-use planners have found the insufficiency or incomplete status of maps provided to them by government or industry to be a significant part of the negotiation over specific projects.

> *"…because especially when it comes industry, it's very heavily regulated so they have very small mandates on what [industry] is required to look at [in maps]. In terms of when they are required to apply for different permits or tenures. It's our job to really expand their scope and push them on really specific issues that they wouldn't normally look at."* (LUP 3)

Another issue raised by informants is the way in which individual industry or government maps often show the impact of a single land-use decision or proposal, such as a coal mine or hydro dam. This presents the audience with a distorted picture of that impact—that it exists in a "vacuum"—without the context of other projects on the land and over time. Often proponent maps address these projects in isolation, while First Nations and conservation organizations have long highlighted concerns around the pace and scale of intensive resource extraction, without a process to determine the *cumulative* impact of such development on local communities and their shared natural resources. Cumulative effects are defined by the Province of B.C. as "changes to environmental, social and economic values caused by the combined effect of past, present and potential future activities and natural processes"(Government of BC, 2016). Mapping cumulative effects could be a tool for placing a single land use decision in context and allow for a more holistic depiction of the state of the landscape.

> *"Yeah I think sometimes cumulative impacts are almost overwhelming for some people. It is really powerful [to see], but then that also charges you to work cooperatively with others to disclose information about your plans that you may not want to do. It also forces certain groups to have plans and make those public. I think we're still in a situation where information is really not shared with certainty for*

> *upcoming development. Some people wouldn't want to divulge how they want to use the land base unless they were pretty sure they could have had some certainty to it."* (LCM 4)

Government and proponents have gained a reputation among the First Nations and other community land-use planners as unwilling or unable to produce maps that show these cumulative impacts. As the last quote shows, developing these maps can be 'overwhelming' and are time-consuming projects.

> *"They could add more layers so we could look at cumulative effects, [but] they send you one layer for their project only. I guess the main thing of the province, what we want them to do, is to send us annual summaries of all the activities and it's a huge challenge for the government to do so. They have two hundred wind projects, we don't want one map for each of the two hundred, show us one big map with all the two hundred on it. It's very challenging for them to do that. They do not like doing that."* (LUP 3)

For land use planners interviewed, a map that shows only one project in isolation is misleading, as it implies the impacts of that project will also exist only in isolation. It may be policy of industry mappers to only account for those projects for which they are responsible, but it does not present a wholly accurate depiction of the landscape. A counter-mapping practice could be a means of showing all cumulative effects of resource development over a large area, allowing a community and land-use planners a broader view of the land and how an individual project fits into the larger patterns of development. Mapping cumulative impacts is something the government of BC is now engaged in. Three informants; two land-use planners and one local community member, mentioned the term 'cumulative impacts' a total of fourteen times.

Counter-mapping as a practice allows a community to build a stronger position as part of a negotiation with industry and government, forcing proponents to address inconsistencies and gaps in their mappings to the benefit of the community and to projects as a whole. In the long

run, building trust through accurate maps is a two-way process, according to the examples above. This two-way process applies to any organization or individual seeking to take part in a land-use negotiation through spatial mapping, including conservationists and conservation organizations. The way industry is portrayed on a map by conservationists is often used to tell a story, which can be a misleading one as well. In the PRB this story has been about the intensity of industrial resource development and its impacts on the land. In showcasing some of the early maps produced in the PRB digital atlas, informants were quick to point out some displays that told this story in a potentially misleading manner. Specifically, oil and gas well-sites plotted at a larger scale tend to show an overwhelming number of individual impacts (Figure 7). One local community member called attention to the implications of this display.

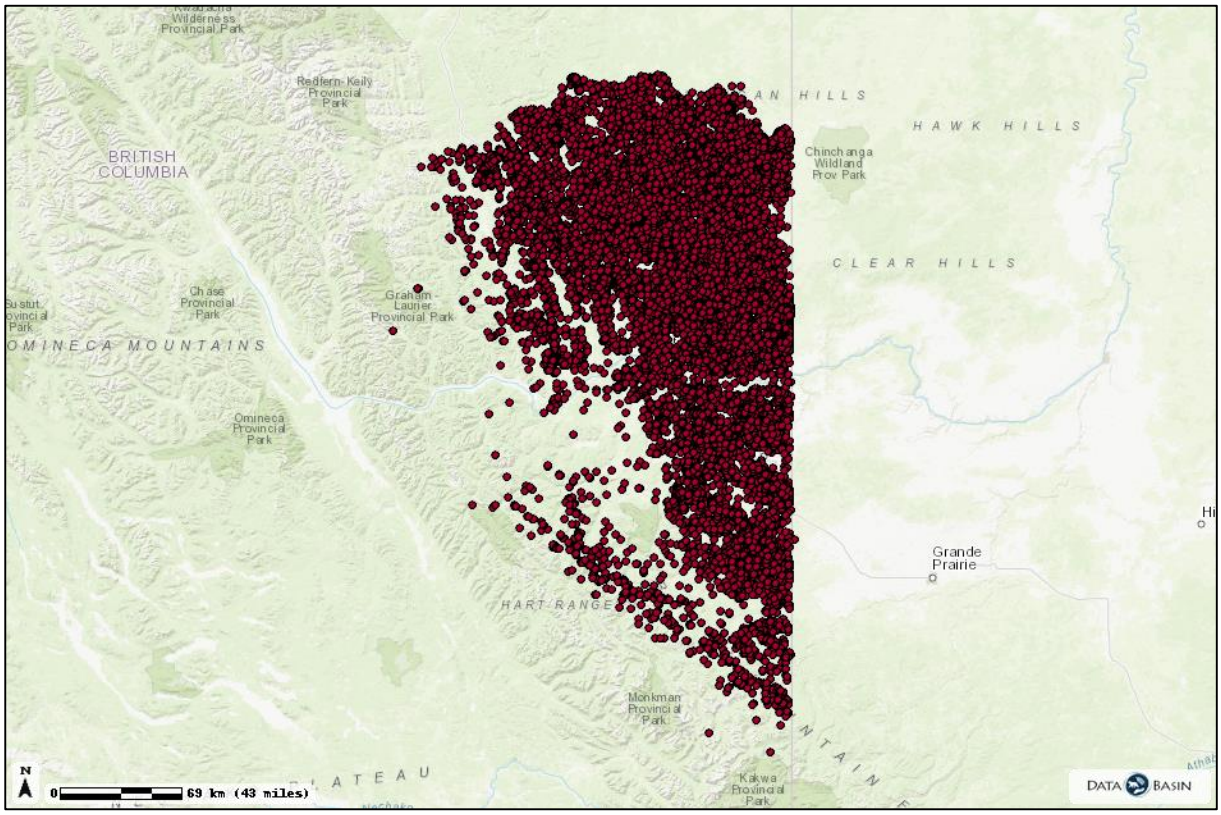

Figure 7. Oil and Gas Well Locations in the PRB. Tim Burkhart, 2014, Retrieved from: https://databasin.org/groups/49043197f4a44333bff8cfcc8935666f

> *"Now just one second here. Now each one of those well site circles [on the map] takes up 100 acres or more...I always kind of wonder about that, though, I mean, it makes it look like it is one solid well site from here to the borders. But now I realize where you have a well site there's an area that's impacted around it, but I always kind of question that a little bit. I mean there are that many oil sites, but they don't necessarily cover that exact area. Like probably within that well site spot there's Wildlife habitat, but that's not really disturbed."* (LCM 1)

Using maps to tell a story that could be misleading is therefore not just the domain of industrial proponents, but potential opponents as well. Issues of scale and display are ones that continue to be raised. The informant was correct to question the display scale of well-sites on the PRB digital atlas, and ultimately the resulting correction strengthened the accuracy of the tool itself, perhaps at the expense of the 'shock-value' of seeing the cumulative impacts of oil and gas development in the Peace at a broad scale. The PRB digital atlas was intended to be a fair and accurate tool that could guide industry and government proponents as well as conservationists, so this critical feedback aimed at fair and accurate representation is was crucial to its success in the long run.

An open access, publicly-available, and transparent process for mapping land-use will therefore strengthen the accuracy of a map, and having a multitude of voices can help reduce inaccuracy by leading to peer review and critique, as well as information to corroborate other maps and land-use research. As was noted by informants, striving for accuracy—telling the truth—will benefit a cause over the long-run, even if it diminishes a compelling story. Not only does peer or community review of maps push greater accuracy and truthfulness in display, but can be an important tool in building trust in the community. Similarly to land-use planners using counter-mapping to fill in gaps and inconsistencies in proponent maps, peer/community review of maps can help to identify landscape values and features that may have been overlooked. Participatory mapping was not used specifically in the digital atlas

case study, but the Data Basin platform is itself designed to offers a participatory component. One land-use planner informant involved in participatory mapping found it to be an incredibly valuable tool for trust building and identifying features that may not be readily apparent without local knowledge:

> *"That helped to build the trust because it helped to identify the resources. So if you see the participatory map, it was just a sketch map, but still it was a strong tool to know the borders, the boundaries [of resources of value to participants]*. (LUP 6)

Curiously, the fact that participatory maps have been criticised for their precision does not necessarily mean they are any less truthful. Important community involvement is important in building trust as well as in helping to identify community values and other features. The lack of technical ability by most community members, results in features being represented in ways that are inaccurate, in a technical sense, but representative of participant expression of values. For a land-use planner informant that had engaged in participatory mapping with Indigenous communities, this representation was more important than technical accuracy:

> *"Accuracy isn't important, it's more representational. When it comes to the community, a slight overlap [or inaccuracy] doesn't matter. In the participatory maps there was no accuracy yet it was very effective. In a participatory map they would delineate a stream and it doesn't need to be exact. It's just an indexing [of resources]."* (LUP 6)

Here the inaccuracies in the map are not necessarily biased to suit a specific agenda, but rather the result of a different purpose or value of the mappers, which was to identify resources, like a stream, that were important to the community. Bringing in local knowledge was useful in enhancing the accuracy of the final mapping product. More importantly, it helped to build trust among the individuals and organizations doing the mapping, and enhanced the credibility of the final product in the community's eyes.

The literature and pronouncements about open data, besides supporting government transparency, indicate significant potential in improving the value of maps to a broader community (Cowan, Alencar & McGarry, 2014). The first is improved public trust in the process, in the credibility of the maps and mapping products and the individuals and organizations doing the mapping. The second involves accessing and combining data in new ways to create value for both the community and the organizations, be they industry, government, or ENGOs. An open, accessible and transparent tool will serve to enhance the accuracy of all mappings done in the study area, as it encourages a counter-mapping process of rigorous debate, public input, and offer a contrast by which to measure other mappings.

5.2 Counter-mapping Provides a Pathway to Engage Land-use Planning with Legitimacy

As part of developing the digital atlas case study tool, I solicited input from interview informants in the communities of interest into how they were currently engaging in mapping, counter-mapping, and how a digital tool could assist in these processes. Local communities engage with the land through direct experience working, or recreating, but how these communities engage with land-use, and planning, can be enhanced through maps. “As an inherently selective view of reality, the map often becomes a weapon in adversarial negotiations between developers and local planners” (Monmonier, 1991, p. 71). Counter-mapping is an every-day practice for planners and mappers for First Nations and some community organizations, and also for conservationists, whether the practice is intentional or not. “Understanding cartographic manipulation is important to being an informed citizen able to evaluate a wide range of proposals for altering the landscape and the environment” (Monmonier, 1991, p. 86). Using maps to seek to redress inconsistencies, inaccuracies and

outright injustices in land-use decision making by authority, whether state or industry, is a common practice for those who are involved in land-use planning. There are organizations that work to embed this practice in the developing world, as a component of decolonization; "most maps in use today serve to reinforce colonial understandings of the Earth, we are consciously creating maps which help us to re-imagine the world – to decolonize ("Decolonial Atlas", 2014).

Counter-mapping in practice worked differently for different informants in the PRB and beyond. It has been used as a tool for speaking back to power, and also in potentially bringing more voices to the process, and negotiations, over land-use. Addressing the ways in which maps can be misleading may simply require filling in features or values missing from a map produced by government, industry, or ENGOs.

Which features on a map are included or excluded, as well as map scale and available data, among other things, are subject to the map-maker's agenda. In land-use planning and conservation, speaking back to resource development through mapping can be as simple as correcting industry or government maps with features that were overlooked. Whether bias is intentional or not, counter-mapping to ensure that certain values or features are displayed in the context of land-use is a practice that several informants described.

> *"I've utilized different conservation layers, where there was a proposed dam to look at what areas would be flooded by a dam. And so they provide you a map, and you take their proposed flooded area, and you put your own layers on it so you can see what kind of habitat would be impacted I've done that. I've done work where there have been things that have been missed, so you produce your own map. So I have done maps to refute other maps."* (LUP 2)

This can be seen as a negotiation between two parties over the rhetoric of geographic features, and examining how certain features and values are labelled, presented, or omitted—and

refuting them when they are incorrect, biased, or do not accurately reflect one party's values—are a foundational part of counter-mapping as a practice:

> *"When we try to look at impacts, for example, we make a map with the Williston Reservoirs [labelled] like manmade structures. We'll change the labels [of other maps] to not say Williston Lake, it's the Williston Reservoir, and we'll also put it as a different shade of purple. Then people ask questions. Industry and government [ask] how come that lake's purple? Well, it's not a lake. It's a reservoir. It's identified as an impact on the map."* (LUP 3)

The above quote from a First Nations land use planner is an excellent example of counter-mapping practice. In the case of Williston Reservoir, insisting on its labelling and colour-coding on the map as distinct from natural features is important in that it reminds the map's audience that the Williston Reservoir is a human-made impact, with a distinct history and context. Ensuring that a community's values, which could include traditional lands, critical habitat, or wildlife values, are included as a feature in resource development maps can demand that the potential degradation or destruction of those values be acknowledged, and presents a visual argument for mitigation, restoration, or opposition to that development. For a conservation advocate informant, the insistence on including wildlife values on a map resulted in the protection of those features:

> *"We got the Forest Service to back off on major logging in some parts of some different stands [of forest] that we could prove Wolverines were using, because of mapping we had done." (CA 2)*

Maps showing proposed or even completed impacts from human-caused development are not always publically available or accessible. Where this is the case, counter-mapping can involve highlighting existing resource development or industrial use on the land, showing the cumulative change on the landscape over time, or combined anthropogenic features on a map. For local community members, these were potentially features of interest:

> *"Most maps would have not shown development. Not maps that the public could easily access. Just recently, [I had] a conversation over a missing map, or what's not on the map that could make or break a legal challenge. That's the [importance of] unlogged watershed maps and protected areas maps that came out, because people really sort of visualize what was going on the landscape. In terms of the public, once again unless you had a deep interest, the public wouldn't be aware of most of the development. The area is intensely [developed], how do you mark those thousands of kilometers of roads on a map? How many people have the ability to grasp the scale of it in a way?"* (LCM 3)

Maps that show human caused disturbance or infrastructure can be compelling and effective in advocating for the conservation of remaining 'intact' lands. Figure 8, from the PRB digital atlas, shows the combined human disturbance or access throughout the Peace River Break region, with each linear feature (road, pipeline, transmission line, seismic line or other anthropogenic infrastructure) buffered to a 50m standard. The result is a striking visual of a landscape thoroughly penetrated by human-made features, and with a bright red colour, is intended to elicit shock at the pace and scale of human impacts on the land, while also drawing attention to the intact corridors that exist as potential candidates for protection of 'what's left'.

Industrial development in areas valued by local community members can lead to efforts to build literacy in mapping work. This informant was discussing another case for a similar project to the PRB digital atlas, this time on the coast of southern BC. For this informant, building map literacy was seen as a way of bolstering conservation advocacy with the legitimacy and authority that maps offer.

> *"Our big issue here is logging. Obviously we've got climate change coming out with a whole lot of unknowns, but mostly we've got the forest industry, so we're just trying to engage people. The project actually started because we didn't have any way to comment or put a stick in the spokes of various logging firms and you know, aside from standing in the middle of the road, we have very little opportunities to be part of any decision making process. So we just kind of stepped back and said screw it, we're not going to be able to do anything, they're going to do what they're going to do, and*

until legislation changes, our hands are tied. We decided to just arm ourselves with information." (CA 3)

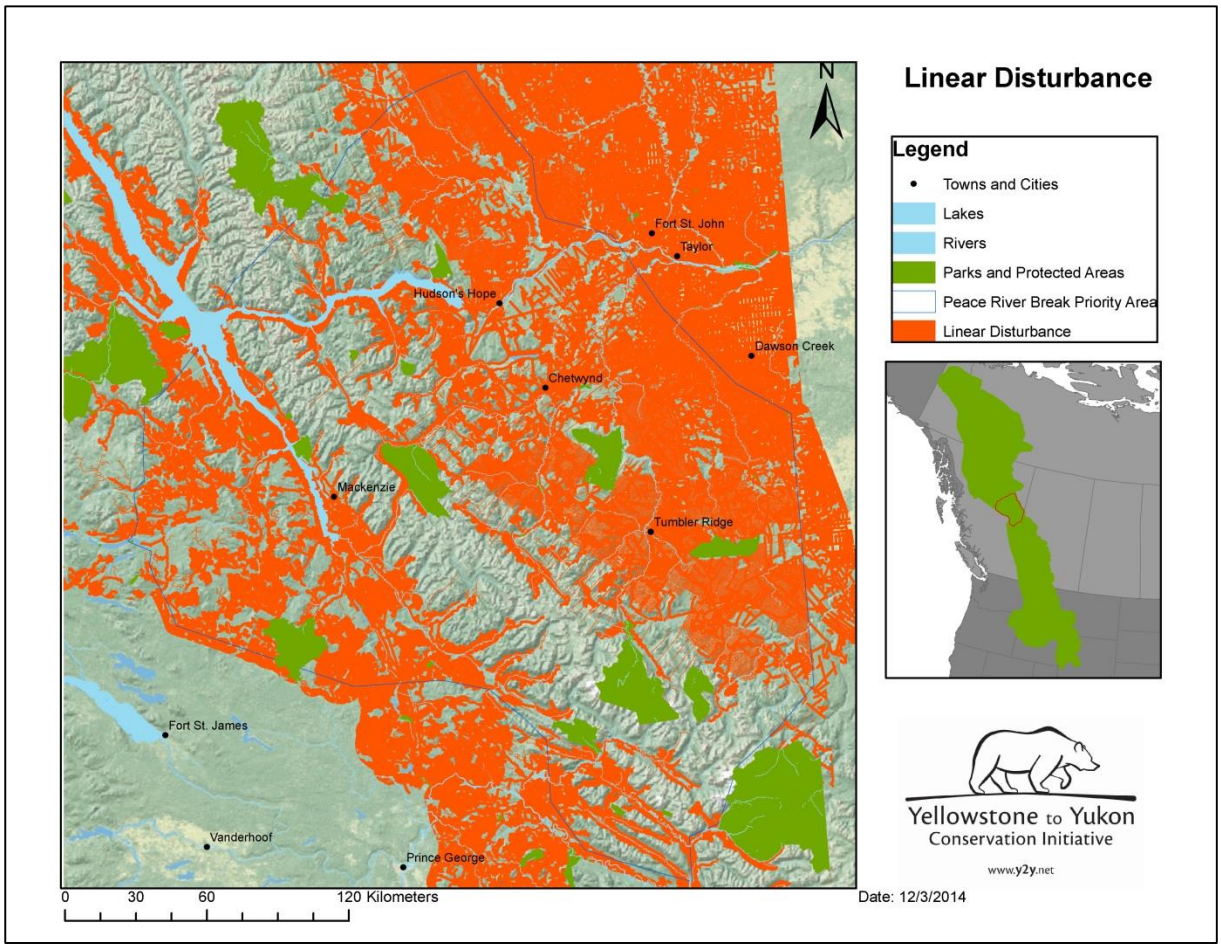

Figure 8. Combined Linear Disturbance/Human Access in the PRB. Tim Burkhart, 2014.

Arming a community with information and the means to visualize that information spatially gives that community authority and legitimacy in dealing with powerful interests like resource companies and government agencies. It also serves to empower community members with that knowledge and authority, and give individuals a place in the process of land-use decision making. For some mappers, such community engagement is very much worth the effort, and one First Nations planner found that building map literacy in the community was valuable:

> *"We are looking at projects within the vicinity of our community, but if there's a factor like a big pipeline that transects it, then we're definitely going to engage in those discussions. We've been working with counter mapping in an indirect way, so it's been kind of interesting to see the reactions from people that aren't really familiar with it. It [counter-mapping] creates a cultural awareness to [the land] as well, it kind of gives you back that independence."* (LUP 3)

Communities engage in counter-mapping to both connect their values and knowledge to authority in dealing with industry/government, as well as bring more individuals into the discussion on land-use. In this way, counter-mapping can be a process that serves to enhance the legitimacy of a community narrative, add authority to their advocacy, and engage people in their community.

> *"One of the whole goals for the [community mapping] project was to increase community awareness and build up a community base of understanding and appreciation and concern about what's going on. How do we enable people out on the land to tell us what's there? If we get the information, we can map it, but we're not. We can't be everywhere, we can't map everything, but if we can interest citizens in telling us what they're seeing, we can make an interest when they're out there opening their eyes and noticing things, you know, we can connect it to a community database. We can create whatever kind of map layers people are interested in collecting. Maybe it's somebody's wacky interest, or maybe it's a general interest in mapping big trees or salamanders or some species or who knows what. We're finish up a draft of a guide to sensitive ecosystems, so we're trying to inform people in a very simple way."* (CA 3)

Many First Nations communities in British Columbia have developed extensive GIS mapping capabilities and staff as part of the land-claims and treaty process, as well as to support decision-making and the issuing of permits for resource development on their traditional territory. For First Nations, counter-mapping has been an extremely useful and well-used tool to reassert title and authority over land, as well as to map various types of community-held traditional knowledge. First Nations lands department staff deal with industry and state maps on a daily basis, and often have to engage in counter-mapping practice to redress biased and exclusionary representations of land, their values, and even the boundaries and qualities of their traditional territory itself.

> *"There's that saying that everybody refers to [that] maps were used to take away land from First Nations and one of the biggest things where the wars were fought were on maps. So now we have an opportunity to use those maps to reclaim things because we're in control of that information. We're publishing it. We're displaying it. Our interpretation of it. We can use that to develop some mutual understandings with different so counter mapping is a really big benefit."* (LUP 3)

For First Nations, counter-mapping is used to assert rights and title, and visualize traditional understanding of the land. As a First Nations land use planner described:

> *"So what we do…for counter mapping for example: if I put a map of Treaty 8 up there, then I dissolve the provincial boundary, so you'll see just this is Treaty 8 there's no divisions. It's just one consolidated thing. So we do a lot of that stuff and we use mapping to assert certain things. There's a lot of confusion in terms of jargon around traditional territories and consultation boundaries. A lot of the time the traditional territory word gets thrown around quite a bit, but it gets applied to the wrong things. Yes this is a consultation boundary with a certain ministry that they give us referrals [for] and companies start using them. They say this is your traditional territory. This is the only area we're going to assess the project in. The only area we're going to identify impacts in. Like no, we actually have treaty rights that expand beyond that."* (LUP 3)

So counter-mapping in practice means reasserting the values and truths that are important to these communities. As with all negotiations over land, First Nations have found that they must use the tools (maps) of the dominant society in order to demonstrate the legitimacy of their claim to the boundaries of land (Rundstrom, 2009). As this mapper explained; resource companies and government produce maps and other documents that purport to show their traditional First Nations territory, and therefore the area in which a First Nations impact assessment would be necessary, but often represent the area incorrectly. This diminishes the size and scope of the boundary in which consultation is necessary, according to the state, and therefore requires the First Nations to counter-map in order to assert their territorial interests:

> *"I guess from the political field too, the other issue [is] the self-determination thing. It goes back to us to tell people where we are. This is our traditional territory. Sometimes we're kept out of that conversation and proponents or industry or different stakeholders will go to the government to ask them where our traditional territory is. That's where a lot of misinterpretation comes from. So we'll get the [partial] proposal*

> *from a company and [it will] say we looked at your traditional territory. They'll have a map in there and they'll try and tie it to reviews to say this is our scoping area. So we have to really pay attention to those details, assert those things ourselves and really let people know that we're in control of that. That we're the ones that are going to tell you where our traditional territory is. We're not going to rely on other people to do that. I wouldn't tell you where your province is there, where your city boundaries are. [This is] not something people realize is happening to us. Where people are telling other people: that's your traditional territory but it's actually just a consultation boundary, tied to a different process, and that's where a lot of misinterpretation happens. So we really bang heads at the beginning of the process trying to iron out where that traditional territory is and that's always a big issue."* (LUP 3)

Better informed residents are able to better contribute to their community. Using a map-based engagement methodology has allowed community groups to visualize and analyze local area values in the context of a particular issue, question or concept. Participatory mapping techniques are effective in also better informing decision-makers, and in arming advocacy groups with data and maps firmly grounded in community values:

> *"Some of the things that help are those that come through the participatory mapping. [Participatory mapping] helped to delineate the areas between different communities, and helped us to walk through it with the real users. It helped us to know who was protecting this forest, so when it came to handing over the process, it helped. Like, that mapping helped us. We didn't have any advanced image or satellite image to delineate those resources, we just went, draw the sketch map and based on that map we knew what boundaries were in a natural state yeah? So and it was plain, simple maps, sketch mapping, still it was effective in some way."* (LUP 6)

So the process of participatory mapping itself can both empower communities and provide a more precise understanding of features that would not be easily mappable without community engagement, in this case how communities use the resources on their land.

5.3 Digital Mapping Tools Can Assist Communities in Counter-mapping Practice

Participatory engagement with communities can serve to enrich the precision of mapping and provide much-needed input of local values into the process. Digital and mobile mapping tools

can provide assistance to communities in planning and advocacy for land-use and conservation.

> *"We have some communities with a thousand, some communities with several thousand [values], even spread out. But the app [participatory mapping application] is just like, show me a place that you love. Put your finger on the map and it'll register a dot and you'll just get them to tell you what they know about a certain place. It populates the map and my hope is it will populate the map in a way that's even bigger than: I've been there and I've been there and I've been there. If we can put dots [showing values] all over the map and then…have that [made] public, and then let industry see that we know what's out there, we've been there before, you can't just take it away."* (CA 3)

In the Peace River Break, there was interest in a tool that would help communities in this way; by providing them with the information and the authority to present their case to industry and government, for certain features or values. A digital atlas tool can also build up understanding for researchers, ENGOs, and the local community itself, of what those features and values are. For representatives of the First Nations I met with, this latter piece is incredibly important in the exchange of traditional and local knowledge across generations and between Indigenous and non-Indigenous communities. When asked about a digital atlas tool, a First Nations land-use planner replied:

> *"Absolutely we've had some interest in that [the Digital Atlas]. Like I said a lot of these [community mapping] projects are funded, and there is certain limited scope in there. So we can only interview people for a limited amount of time, but I'll get people coming back and saying 'hey I remember this one time I went here and map that.' OK, so we kind of do that. So I've been brainstorming ideas of how to do that: providing people with their own user account so they can see their existing data. Start actually adding to it and stuff, making comments on it, if they would like it adjusted or they had flashbacks and those kind of things. So we haven't really developed any kind of dedicated web mapping tools right now. But it is something we could deploy rather quickly if we really needed to. It's just a matter of gauging what type of interest we would get through that."* (LUP 3)

The individuals I interviewed all expressed an interest in how counter-mapping could be a valuable tool for their communities and organizations, and recognized the importance of

mapping in the PRB given the immense pressures on the land and people and the rapid pace of change. But the challenges in engaging these diverse communities in mapping are great.

5.4 Accessing Mapping Data is a Major Challenge

There are significant barriers for community and grassroots groups to accessing digital mapping data to assist in conservation and land-use planning goals. The costs, training, technology, and time, in addition to the collection of data, are a major challenge. "These start-up costs for GIS continue to function as barriers for comparatively resource poor institutions in all parts of the world" (Elwood, 2006, p.263). These barriers were one of the main reasons for the development of the Data Basin platform: "mapping and spatial analysis are a fundamental part of problem solving in conservation science, yet spatial data are widely scattered, difficult to locate, and often unavailable" (Comendant et. al, 2009, p.1).

Would-be community conservation mappers still face a range of technological, organizational, and institutional barriers in using GIS. Training, funding, and data issues are among the most significant barriers preventing greater use of GIS for community planning purposes, while trust remains the most significant barrier to collaboration among community groups, First Nations, ENGOs, industry and government (Göçmen & Ventura, 2010). "In many instances, the barriers to finding and implementing solutions are more constrained by political and social reasons than by the lack of scientific or technical knowledge" (Strittholt, 2010). This was the case for the Digital Atlas. Mapmaking in a landscape with the complexity of the PRB is a political exercise that can be controversial, and has the potential to alter existing dynamics between groups and communities. As Harvey and Christman (1998) note, "the construction of any technology takes place in a distinct localized environment

which strongly constrains how actors interact with each other and the artifacts they construct". How these actors utilize map-making as part of an ongoing negotiation over the land, and how barriers to accessing maps and mapping information impact these interactions is critical to understanding the political power of maps in the PRB. Getting the data is part of a negotiation over the land, and is influenced by, and influences, the power dynamics of that negotiation. It also alters where and how counter-mapping can occur.

Land-use has always been a contentious and deeply political practice in the PRB. There are multiple competing visions for land-use in the region. Many communities, including First Nations, realized that to protect their interests they had to begin mapping—delineating their areas of critical concern, specific values on the land and understanding change over time. For First Nations and other lands managers I interviewed, barriers to counter-mapping included the failure of industry, consultants or government to share maps that included important values.

> *"Well in the past we had a lot of different contractors using different systems and some of them didn't…they weren't [collected], or the data wasn't publicly available. We didn't have the knowledge, we weren't doing the mapping historically, previously, prior to hiring a [GIS Manager]. So in the past we had all these different people extracting knowledge and then making sure that it was [collected] after they left was the challenge. So as a solution we have only one consultant we work with and work very closely with the [GIS Manager] and we house all the raw data here."* (LUP 1)

Another issue is access, as I found when putting together the digital atlas.

Actually tracking down the data from across varied organizations and custodians was the single biggest challenge. Participants had similar experiences, and tried various ways of negotiating this barrier. One land-use planner noted how dispersed the data can be:

> *"We have to contact different people, companies, organizations, departments to grab all the data, [it's] not always online." (LUP 5)*

Tracking down the maps that accompany information provided by industry or government for public comment on projects can be equally challenging. A conservation advocate noted the difficulty of getting good data and maps along with public notices:

> *"And they won't always provide the maps in there, depending on what they think you're going to do with it. So yes, information has been scarce in a lot of situations and poor, like poor quality." (CA 3)*

This challenge was met with the development of a robust in-house GIS department for a First Nations community with which I engaged. This is a common theme among First Nations in the PRB, and for Indigenous communities world-wide. By hiring their own GIS Manager, the First Nations community was better able to assert political power in the interactions between interest groups in their traditional territory. As the land use planner of this Nation noted:

> *"It is my understanding, if regular users, non-GIS users, if they want to understand a map or the data, I guess for now [they] have to depend on my work—GIS person, GIS technician work—to create specific data or [provide a] map to them. Then it is much easier, otherwise I don't think it's easy to understand."* (LUP 5)

The creation of a specific GIS person for the First Nation alone did not remove all barriers to access of critical mapping data, but has served to better identify and work to overcome them. Many community members have extensive experience and knowledge of the land, often in a far more detailed and ingrained way than mappers from an outside organization. But barriers for these actors are significant—those who do not possess the technical knowledge, training and equipment to utilize a GIS, like most of the public, require a technological gatekeeper to translate their experiential knowledge into a digital format. One land use planner noted that training and map literacy could be barriers to participatory mapping projects, but recognized the need to translate community-held knowledge into a digital format:

> *"Sometimes it can be difficult, because it's kind of technology-based thing. So whether it's for the GPS device or the tablets, some people do struggle with adopting that kind of technology but they are very knowledgeable about the land."* (LUP 1)

In this way the data custodians also act as interpreters and gatekeepers. This challenge is obviously greater where computer literacy is lacking.

> *"For me, I come from a developing country where we have no access [to GIS technology], and we work with the people who haven't even have seen a computer in their life." (LUP 6)*

Importantly, there was a sense among informants that emergent technologies offered promise for making mapping easier to use, but also a desire for simplification that could undermine complex data.

> *"We need to figure out something to make that more accessible for all of our community, or those who want to, and it's probably only, you know, really probably only a few people will be entrusted in getting that in, but having said that, maybe it would be more if it was simple."* (CA 3)

Building a tool like the digital atlas therefore requires not only technical knowledge but outreach and education skills and effort as well.

> *"If only data, or layers or like right now in government they have iMap BC, you can pull out some data to make a map really quick, but still I believe if you don't have basic GIS training or those knowledge, you don't know how to do it."* (LUP 5)

While technology, cost and training are significant impediments for community engagement in mapping practice, the main barrier identified by interview informants from First Nations has been a common one in my own work on the PRB digital atlas—collecting and sharing existing data from other actors. A First Nations land use planner articulated this challenge:

> *"It's a big struggle…it should be publically available, we just want the layers, I don't know all the terms, but that's been a challenge. It's publically available data…[but] when we have got to go ask for it, it's a huge struggle. We're constantly trying to go through this paperwork and the time. It's definitely not something that's easy to do."* (LUP 3)

In this case, not only do you need to be a custodian, mapmaker, and interpreter, but also a negotiator as well. Even some government land-use planners expressed frustration with identifying the relevant data behind maps used in land-use planning or industry projects:

> *"I've found it very challenging, sometimes [it's] very hard to get the data you need. When people need some data they say: I want LNG data, but where is this data? Sometimes all this data is hiding in one geodatabase, like a whole package, or one attribute table, and you have to find where it is. So if you don't know the source, if you don't know the geodatabase, it's very, very hard to find it. And usually it must be somewhere, but just very hard to find out." (LUP 5)*

Government public data should be more accessible, with an access point that is easily identified and comprehensively provides public information for community use. Even when mapping information is more forthcoming, as processes developed by land-use managers require the inclusion of data and metadata in industry/government referrals, the quality of the data can remain a significant barrier. Whether intentional or not, incomplete or poorly developed maps and mapping data can serve as an impediment to entering into a full and fair negotiation between parties. As one land-use planner noted:

> *"We deal with it all the time. They send us maps that are not complete, they should have more layers on them. They should be more site specific. It's very common. They [industry] have very poor mapping skills initially." (LUP 3)*

Most often in my experience, the challenge of identifying and collecting mapping data was not caused by any sinister intent on the part of industry, government, or other organizations, but rather a lack of capacity—the custodians or gatekeepers did not know where the information was, or what format I needed. This concern was shared by a land-use planner I interviewed:

> *"Yeah so one example is a deal with mines. So we get maps that are so zoomed in, without any coordinates on them. So we have no idea where the map is, like where the location is. So we'll often go through what the person filled out online and find the coordinates and try to do that mapping that way. So again, [we're] doing their job. So*

> *we can't even read it, we don't even know where it is. That's been improving after much comment, like a lot of comment, but that's been a real challenge; they're not even readable." (LUP 3)*

Sometimes the mapping information was incomplete, or of poor quality. Occasionally, it was made available, but not in a data format that was of immediate use to the land-use planner or conservation advocate. Time and labour would be required to change the file format; in some cases from a paper physical map, or image/document format, which would require additional tools such as a scanner to digitise it. This would also require the recipient to spend time overlaying it in GIS through a process called geo-referencing; assigning coordinates to each the file based on identifiable features on the image or map. This is assigning new labour and time to the recipient, which can be a barrier in itself. Land-use planners were especially concerned about this barrier with regards to industry projects:

> *"It was really frustrating because the information was publicly available already. I can sit there and digitize it, but it's not feasible. Trying to explain that you have shared that information with me already, just not in a format that I can make use of it. So put it on a map. How is that any different from me wanting to make a map with that same data? Why are you so conflicted with this? I don't understand this kind of thing. You have to really go back to GIS 101 with them, So don't be afraid to share information you already have, it's public record."* (LUP 5)

In other cases, the barriers between different organizations, government agencies, or ministries, serve as an additional barrier to community and First Nations getting the correct information.

> *"They don't send you, like with the files, they don't say: 'this is within your boundary here's the map showing that.' So the lack of data [requires us to] have the conversation with the province about all the different boundaries they draw up for consultation, depending on the industry. So the [Oil and Gas Commission] will have their own boundary, [Ministry of Forests, Lands, and Natural Resource Operations] will have one, you know, [Ministry of Aboriginal Relations] will have their own boundary…but they aren't able to show a map of all of them together. So we want to eventually blend them."* (LUP 3)

These issues have resulted in the recognition of a need for standardized practices for land referrals, but also for a robust capacity for First Nations and community stakeholders to complete their own spatial analysis and the ability to make maps. The costs related to building this capacity, in terms of both money, time, and technical training, present further barriers.

> *"Proponents have been a little bit difficult, because there is, for some industries, no standardized submission. So, for example, if we get a cutblock referral, sometimes we don't even get the cut block shapefile. We just get pictures and it becomes more difficult to assess. So for me to do my desktop review it turns into half-a-day instead of 20 minutes just to get the right information, finding that location and everything.*
>
> *Sometimes, [you have to do the mapping yourself], you have to digitize and everything and so it can draw it out. But we're working with forestry right now and FLNRO specifically to change that, to develop some standards for data submission so we have the right information when it comes in."* (LUP 3)

The implication of these barriers to accessing data are that decision-making for land-use and resource development at both the government and local community or First Nations level are not as well-informed as they need to be. Government data must be made more widely available through their open data repository, and where information is missing, should be identified and developed.

5.5 Some Barriers to Data Collection are Valid to Protect Sensitive Values or Features

There is a distinction to be made between withholding data for political purposes and protecting value features that may be compromised if shared. There are also legitimate political reasons to withhold some value features from the public or wider audiences. Conservationists acting in the PRB have to be especially conscious of their role in the negotiation over land-use, and how maps can potentially compromise their intended activities,

such as the protection of key value features through private land acquisition for conservancies. One conservation advocate noted their concern with sharing information:

> *"We've had quite a few discussions on how much information we're going to provide them and even a location. I've looked at a map [of] let's say a wetland area, and mapped and georeferenced it and I've attached that location to the spreadsheet because [it is an] area of potential mitigation value. So then the discussion is well, so Joe Public gets a copy of this report and here he's looking at it, and says 'hey there's a dot on my property, that, you know what are they doing on there? They're targeting me!' So there's that kind of concern, and I think that's a valid concern at the same time. My argument was: well there's nothing preventing me from looking at anything on Google Earth in that spot."* (CA 1)

While an open, transparent and publically available mapping process might be an admirable goal that could open up discussion and negotiation on land-use to a broader community, for some actors this would result in a significant disadvantage in these interactions, especially if other actors are not as forthcoming. Both a conservation advocate and land-use planner spoke to this concern:

> *"I don't know, we haven't got to the point yet where we're willing to make shapefiles available. To, you know, to the public. It's always been [on a] case by case basis." (CA 1)*
>
> *"Yeah, right now, I'm dealing with, mostly traditional-use for First Nations. They always want to keep it confidential." (LUP 5)*

There is also a compelling argument that as GIS datasets have value, as represented by the time, cost, and expertise put into their development, the creators have a legitimate claim to protect and guard those data. In the case of data collection for the PRB digital atlas project, I found it frustrating to walk the line between protecting valuable work and ensuring that work was valued as part of land-use planning and conservation a frustrating one to walk.

The most challenging part of the digital atlas case study project was to identify and collect relevant data, where the issues of access were similar between government and other

institutions and organizations as well. Y2Y has a 20 year history of supporting scientific research throughout its priority areas, and has contracted researchers to produce voluminous studies on wildlife, habitat, geography, geology, connectivity and many others. Most, if not all, of these studies have included mapping products as illustrative or in some cases primary information. However, the underlying GIS data that went into the building of these maps was not widely collected by Y2Y, and rather remained in the hands of the researchers contracted to conduct the studies. Some of these researchers made their data available to Y2Y, some had lost or no longer had custody of the data, and some were unwilling to share this information beyond the final completed map product (ie. not shapefiles or .mxds, but rather .pdfs or printed maps). Anecdotally, this narrative was repeated among other conservation organizations I reached out to for data. The difficulty arises in first identifying the custodian of the mapping products and the data behind them, then in negotiating with that custodian the release of the data for public availability. The implication is to be sure that future contracts for Y2Y included possession of all underlying data and metadata for continued use and public availability, through the Data Basin atlas.

The Nature Conservancy of Canada developed a series of 'conservation blueprints', which overlapped with the Peace River Break study area. The data behind these blueprints was identified by Y2Y stakeholders as of high value for conservation planning in the PRB, when overlaid with other features and data. Identifying the custodian of the data behind the blueprints proved to be a challenge, as the authors did not know where the information had ended up being stored. After the information was discovered in one of the BC offices, it was made readily available. Here the act of counter-mapping could be construed as simply tracking down the custodian and negotiating the release of the data.

There is detective work involved in identifying the custodian or gatekeeper with the information. As I noted in my journal:

> *"Getting conservation data—the 'raw' data, that is, shapefiles, geodatabases etc..—from conservation organizations is a difficult task. Just like industry, and in some cases government, non-profits are jealous of the information they've paid for with donor's money and time. Often times it is contractors that are completing these studies, and these are even more guarded of their mapping data. The maps, the finished product, is widely shared, indeed that's the point. But the information underlying it, the individual layers that together build and overlap to tell that story, is controlled strictly by the custodian, and barring an upfront data-sharing agreement, which Y2Y has unfortunately not had in place up until recently, that data won't see the light of day."*

Examining these barriers is critical to understanding the need and utility of a digital atlas, which could work to ameliorate some of the data gaps by providing a free, open and accessible repository of conservation data from partners that otherwise would require a negotiation to obtain. However, many of these barriers have relevance to the usability of the digital atlas itself, and of Data Basin as a platform. Interview informants provided valuable insight into potential and existing barriers, and suggestions for how the project could be refined to overcome them.

> *"Maybe the limitations might be access, and knowledge of the site. And really specific pieces of information and kind of getting a lot different types of useful information in there so that it actually does become something that is more holistic versus you know where people can use little bits and pieces or whatever seeing different things."* (LUP 2)

In my own experience, I found that a specific challenge was scoping the project itself. The goal of driving conservation at the grassroots level is a very ambitious one, which was limited by the available data and my own technical expertise. Other barriers became evident through further interviews. These included:

> *"Probably the web mapping has its own limits right? Because it's stationary, so you'd have to be at your desktop computer of some type of device with connectivity to read*

> *that. Whereas the struggle is how do we get the data when they are in the field to bring it back here? Because I think a lot of [people] want to collect data that way, where it's more recent so they went out last week and they did all these activities and they tracked and recorded it all. So how do we get that back into the mapping system? So it's a matter of data standardization. Making things roll smoothly I guess." (LUP 3)*

Costs came up as a major issue in addition to data.

> *"It's not only access; GIS platforms are so expensive. You can't afford it. So, if something was there, online, and access [was] free, that would really help." (LUP 6)*

Cost barriers are an exercise of power, and a counter-mapping practice would remove the financial burden of accessing spatial data, which the Digital Atlas project attempts to do. Some informants had used, or attempted to use the Data Basin atlas, but found immediate issues with the platform:

> *"Well when I looked at it the other day it seemed like a lot them didn't work or didn't load. It took a lot of time and was confusing and hard to use." (LUP 4)*

> *"It's a very cool site, but the technical complexity of relying on Data Basin is, we think, given our limited tryout in the community, it's just too complicated for most people." (CA 3)*

So the common barriers of technology, costs, complexity, and training still resonate with regards to an online mapping platform. Data Basin offers training webinars for free as part of its service, but reaching out to communities within a large geography is a much larger project than just building the atlas. Training was raised by community members in interviews as well:

> *"And are there any training opportunities planned [or] being offered for people to know how to use that? In terms of obvious groups that would perhaps access it, so West Moberly [First Nations], let's say." (LCM 3)*

Others questioned the utility of the tool for public consumption, emphasizing how it could be used in negotiations with agencies, government or industry by specialists. One conservation advocate noted:

> *"I think that's difficult because, when you when you're at a public meeting, it takes a lot to explain what a map is. It really takes a lot to explain what a map is [displaying], so I think they are of much more use when you're directing it towards an agency or sitting down with the timber industry and [can] say: look this is what our mapping shows. So if we work together, so we both get what we want. When you're dealing with a public meeting, they like the flash. And they want to use you want to hit them with your bullet points, [instead of] what you might say with the map."* (CA 2)

The promotion of conservation data sharing through the PRB digital atlas and Data Basin in general is the potential to promise substantial savings compared to ArcGIS and other costly platforms, better decisions based on the integration of widely held local and traditional knowledge, and other benefits from greater interaction between communities of interest in the PRB. But the barriers to cooperative mapping practice and sharing across organizations, governments and industry are many. There are legitimate concerns over ensuring the proper use and display of data, including sensitive information not appropriate for wide public display. When the results of those datasets could have a significant impact on the land and values on the land the datasets themselves should be shared widely or made publically available and accessible. Custodians and gatekeepers may have critical knowledge in their heads, or on a hard-drive, and willingness to share it can make that critical knowledge meaningful and impactful. Protectionism of datasets behind the map is a way to influence decision making and control, but also must be respected when there is a need for non-disclosure or protection of sensitive features. When conservationists refuse to share data, however, it diminishes the credibility of a desired outcome, as local communities and partners cannot use the information for their own values analysis. Letting the data 'free' can be a form of counter-mapping itself. I will conclude with my own thoughts when struggling to get GIS data—commissioned and paid for by Y2Y for conservation planning and advocacy—that were ultimately not made available by the consultant. As I noted in my journal:

"As two philosophies of the digital age—the open data, open source, freeware philosophy and the concept of living documents, or living projects made possible with the cloud—continue to occupy greater importance in modern science, academia and the working world, the idea of hiding away information will seem unthinkable.

I mean, a year after the cumulative impacts study was released, the information, the precious shapefiles that showcase wildlife suitability and development pressures, are just sitting in a file someplace gathering digital dust. Their usefulness beyond a specific report wanes, and it's a shame that they could not contribute to a more broad based analysis of the Peace."

5.4 A Digital Atlas Could Provide a Pathway for Community Counter-mapping

In the previous section interview informants discussed some of the barriers to community map-making, and data-sharing, across parties. Some of these could be overcome through the PRB digital atlas. In this section, I will examine how the digital atlas for the PRB could deliver results for communities, as well as broader conservation goals in a landscape threatened by development. The digital atlas could also better inform conservation research, decision-making and advocacy in the PRB.

Asserting local community definitions of value features and having the technical ability and resources to display them on a map can enhance accuracy, and a community's authority and decision-making agency over the landscape. First Nations in the PRB have recognized the importance of community-based mapping to provide authority and clarity and communicate their values on the landscape. They have been working to incorporate traditional knowledge into land-use planning and resource development application processes. While the technical challenges are many, some First Nations have made strides towards integrating digital tools with community knowledge, through participatory maps:

> "This type of map can pose alternatives to the languages and images of the existing power structures and become a medium of empowerment by allowing local communities to represent themselves spatially. Participatory maps often differ considerably from mainstream maps in content, appearance and methodology. What makes it significantly different from traditional cartography and map-making is the process by which the maps are created and the uses to which they are subsequently put." (Corbett, 2009, p.7)

Informants spoke of similar projects to the Digital Atlas involving participatory mapping and its efficacy in identifying values and features that would otherwise be overlooked or incorrectly assessed. Participatory and community mapping can enhance accuracy by including local and traditional knowledge, and ensuring local values are reflected in the final product. One land-use planner noted their experience with participatory mapping in the developing world, and how local knowledge was critical to identify community values:

> *"We usually focused on the forests they use. Sometimes the interesting fact was, a village would be in one place, and big forest would be [close by], like just near to the village there was small forest. And when we see, we feel like the people of this village would use the big forest OK? But when you start putting the participatory map [together] and then [ask] which resources you use, how do you use them? Then the result sometimes would be amazing because they would say we use the little forest. Now as outsider like you feel like, the simplest is the nearest. But no, it's not, because the reason they would put up is that because there are [important] areas [close to the little forest], and they would go to work in the little forest, and then collect their things and then they would come back [to the village]."* (LUP 6)

Drawing community members into the process is a tremendous opportunity for outreach and education. For projects dealing with the contentious issue of land-use in the PRB, including conservation priorities and designations such as protected areas, collaborative community engagement of this kind could mean the difference between success and failure. The land-use planner familiar with participatory mapping continued:

> *"So these are kind of information that we'd learn: we'd learn the water resources, where they use it. So it becomes more of a value, [when] it comes to the resource use. This is the making of a more effective, informed decision you can make and be happy with, [rather] than if you had never gone and done that. So you focus all your management plans [relative to these values]. If you focus after participatory mapping*

> *you would focus on this [value], like a forest to protect it and manage it to meet [community] needs."* (LUP 6)

Incorporating local knowledge of the land with the digital atlas could facilitate a greater collection of value features worthy of conservation, adding more voices into the decision making process and strengthening the role of key constituencies in land-use planning. The digital atlas could also help individuals and communities take on a greater advocacy role and actively seek recognition for community spaces through identifying traditional lands and resources, values and interests (Brody, 1981). One local community member expressed interest in how individuals could add their own values to the data basin maps:

> *"I don't see why not. There could to be a layer for people to add their own information. Where are your really key areas? You know, you can have a broad brush. You know this area. You know not to identify where the moose lick is, but in this area it's really important because we hunt there all the time. So those kind of things can be done. It doesn't have to be strictly First Nations, but there are a lot of other local knowledge out there as well. So that people could actually say, OK, in this area it's really key for me and people that I know."* (LCM 4)

It can also build trust within communities as when they engage with the technical side of the process, it can remove some of the misconceptions about a project itself. A land-use planner noted:

> *"We had the same issues at first, like [the] first major roadblock we cleared was to identify the users, and once the users were identified then [to] respect their rights, like their traditional rights. So respect that, and once that is respected then you gain the trust of the people. And then it's more than that. It comes to a stage where it's more beneficial; like you give something and then it comes back." (LUP 6)*

In one early use of the digital atlas tool, members of the Tumbler Ridge Geopark Society pointed out the location of a trail and campsite at Slate Falls on the Murray River, just outside of Monkman Provincial Park. Identifying the location of the falls and the original boundary of the park, as well as the current land-use status of the area as an Old Growth Management Area (OGMA). Doing so presented an opportunity for a boundary amendment to include the

trail, waterfall, and campsite, as well as 800 hectares of intact forest, within an expanded Monkman Provincial Park. The community-grounded nature of this value feature has strengthened the argument for protecting it, as well as the argument for provincial management of the trail and campsite. The area is currently under public consultation with BC Parks as a candidate for a boundary amendment and inclusion in Monkman Provincial Park. (Appendix 6).

Asserting community definition of value features on the map can enhance a community's ability to reclaim and exert authority over land. Before identifying the location of the Slate Falls feature on a map, the concept of adding it to a protected area was not seriously considered by the authorities (BC Parks, Ministry of Environment). Creating a map using the digital atlas tool gave voice to the concept, and presented a tangible goal for those authorities to consider. It also helped to identify any conflicting interests (there was no forest or mining tenure in the area) and existing land-use status. Initially the Geopark Society members drew the area on a printed map of Monkman Park, after which I digitized it and prepared map products for their use in explaining the proposal to their membership, and the wider community in Tumbler Ridge. It was then presented to the BC Parks planning office in Fort St. John. Having a professional mapping product as part of that presentation was an important piece of the success of the proposal. This supports and affirms the point Corbett (2009) made that "to be useful for outside groups, such as state authorities, the closer the maps follow recognized cartographic conventions, the greater the likelihood that they will be seen as effective communication tools" (p. 7).

Maps of campsites and trails are widely produced by the community and outdoor societies in the Peace River Break region, including the Wolverine Nordic and Mountain Society, a

partner of the Geopark Society in Tumbler Ridge. Having this clear record of local spatial knowledge reproduced in a professional and widely recognized format will enhance the capabilities of these communities to inform, and therefore influence, a more community-sensitive approach to land-use planning and resource development in the region. Community-based maps enhance community representation in land-use processes, as recognized by Rambaldi et. al (2006): "these maps can represent a socially or culturally distinct understanding of landscape and include information that is excluded from mainstream maps, which usually represent the views of the dominant sectors of society" (p 7). Using the Digital Atlas to identify community understandings adds to representation, speaking back to power, in this case BC Parks.

Participatory and community mapping can enhance accuracy by including local and traditional knowledge, but also runs the risk of losing credibility as individual knowledge is not seen as trustworthy unless ground-truthed, partially because they are "not confined by formal media; a community map may be a drawing in the sand or may be incorporated into a sophisticated computer-based GIS. Whereas regular maps seek conformity, community maps embrace diversity in presentation and content" (Corbett, 2006, p.7). This is significant depending on the audience of the map. For government and industry, professionalism and accuracy are important components of mapping, and participatory maps could be seen as less accurate.

Informants raised concerns about the veracity of data input into the Digital Conservation Atlas from anonymous or little-known sources without more formal confirmation, while others dismissed this as unimportant. The actual values may not be accurate in the sense of specific geographic coordinates, as "although volunteered information has fundamentally enhanced

geographic data, it has also prompted concerns with regard to its quality, reliability, and overall value" (Flanagin & Metzger, 2008, p.137). There is a valid concern regarding manipulation of mapping data to suit a specific agenda, but also a suspicion among some informants of any maps produced by non-professional mappers who could use the tool incorrectly and damage the overall credibility as a result. Counter-mapping with community-held information is a way of challenging this suspicion where it can be verified. One local community member expressed this concern:

> *"It's important to build into that some mechanism for vetting of that information or identifying it as [community-made] in the process, so [for example] there's a layer that says there's some really important, you know, bat habitat in one area and it came from local knowledge that was supplied online. So you know that probably it is there, but you know it needs groundtruthing to check it out. That should be tagged and identified as such. It's useful, but you wouldn't want to stake the farm on it right? In a general sense if you get five or six people saying that, yeah you've got something probably real solid, but I don't know how you could flag it with" 'to be ground truthed' or…some way of identifying it."* (LCM 4)

Ground-truthing is an important step in most projects that rely on remote sensing or spatial mapping based on second-hand data. Another concern was raised about collecting data as a snapshot in time, rather than relying on modelling which can provide forecasting for future land-use change.

> *"One of the questions I have, and I think I know the answer to this reading it...the data being in there, would be the currency or the date the data was captured within the metadata. It's always interesting to, you need to kind of know at what point in time your information is from, and that's something that can be a barrier in a lot of different datasets is that they happen to capture a lot of things that are old."* (LUP 2)

The process of counter-mapping itself can have value even if the data are suspect.

> *"[Accuracy] wasn't very important. Accuracy isn't important, it's more representational. Like a community is more like a political thing you know? Like you just want to be politically right to have that accuracy, but when it comes to the community a slight overlap doesn't matter. In the participatory maps there was no accuracy yet it was very effective."* (LUP 6)

For the above land-use planner, the process of engaging the community was of greater value than the accuracy of the map, speaking back to how a community counter-mapping practice can embrace a diversity of content (Corbett, 2006). Inaccuracy is also subjective, and depends on who is judging the content. One informant who had engaged in participatory mapping practice were very impressed by the accuracy of community-generated data.

> *"I had a couple instances where people had marked old cabins or sweat lodges or things and I went to GPS them and they were dead on. It was pretty remarkable what some people can do. So we've had a lot of successes collecting data that way. That's very cool."* (LUP 3)

The Data Basin platform has some answers to the issue of accuracy and truthfulness of the data in that individuals must create an account that is tied to their name or Facebook account and therefore provides personal accountability to individual mappings. Additionally, for data collected from non-community sources, the rigorous standards for metadata and citations require to upload information to Data Basin provide a robust framework for trust in its maps and datasets.

6.0 Conclusion and Recommendation

6.1 Lessons for Evaluating a Digital Atlas Tool

The main goal of this thesis research was to evaluate the utility and effectiveness of a digital atlas case study for the Peace River Break for better informing conservation research, decision-making and advocacy, and how this strategy can be designed in the spirit of counter-mapping to be user-informed, community-driven, transparent and accessible. In the development of the digital atlas and associated research, I examined how a suite of social spatial mapping tools can both enrich the data for conservation and bring more people in local communities into the process. This chapter presents recommendations to improve the existing research design and the digital atlas, as well as future studies. The overall conclusion is that the PRB digital atlas, and Data Basin as a platform, can enhance community input and engagement in land-use planning and decision-making, but not without significant investment in time and money from outside experts to provide training and direction.

6.2 Recommendations for Data Basin Modifications

The PRB digital atlas has potential to be a significant asset for communities in the region for conservation planning, and the case study project provided insight into the challenges, barriers, and opportunities that arose in developing and using the Data Basin tool. While the Data Basin Platform is potentially an excellent solution to these challenges, there are still major barriers to using it widely for participatory mapping. Multiple interview informants and users of the tool complained that it was still too technical, and while there is impressive support from the Conservation Biology Institute and the staff at Data Basin for training, as well as multiple guides in different media, it does require computer literacy, a strong internet

connection, and an understanding of the basics of GIS to use in a meaningful way. There are modifications to the platform that could be made as geo-social technology innovates and evolves. The ability to directly integrate of pen and paper sketch maps would be an ideal addition because it would remove the barrier of internet access and computer literacy.

The research community requested initial development of the PRB digital atlas as a way of sharing datasets between partners. While Data Basin provides a solution to this need, the process of gathering data, training individuals in its use, and generating users, was a significant barrier. Sharing spatial data over Data Basin is awkward, requiring multiple steps that could be avoided using a 'cloud'-based technology such as Dropbox/Google Drive. The rigorous citation and metadata capture required by Data Basin mean that shared files have credibility, but the time and effort required to share GIS information in this way push users to find quicker and easier solutions—including physically sending the datasets on external hard drives by mail—rather than using Data Basin as the 'one stop shop' for PRB conservation datasets. The Data Basin requirements essentially forced alternative efforts to share the data, defeating the original purpose of the case study project.

The cartographic tools integrated into the Data Basin platform are impressive, and the multiple avenues for sharing these (maps, galleries, etc.) are a credit to the developers. However, I and other users found that the final map products were not a compelling design. Users including myself found it better to export datasets to a more professional GIS program, such as ArcGIS, for final design and layout because they provided far more options and a much more professional looking result. A major complaint from myself and informants was the lack of high quality base-maps, and the flexibility in design options. I suspect that these

flaws will be resolved over time, and indeed the library of design options including basemaps has expanded since the PRB digital atlas project started.

Data Basin was designed to allow users to "explore ways to provide every stakeholder with accurate, timely information via visually appealing maps, focused apps, and revealing analyses" (Data Basin, 2017). For the most part, it has been successful in doing so, but refinement of these features is required for it to be an ideal tool for grassroots community conservation mapping.

6.3 Research Design

The literature on counter-mapping agrees that one of the primary goals of participatory action research, is to engage community members into the research process (Aberley, 1993). In this research, I acknowledge an issue with myself holding roles as both the researcher and an ENGO employee, and as the main driver of this project. Rather than a grassroots process, whereby the researcher provides more of a facilitation role, I found myself required to not only put the PRB digital atlas together, but lead outreach to develop a user base. While this is a valuable position from which to conduct research, allowing me to examine the process and communities of interest involved from start to finish of the case study, it has implications for the participatory nature of the project itself. While the spirit of PAR was present throughout the concept, design and initial roll-out of the tool, the resulting use of the tool has been less participatory than was intended or is preferable. In developing the case study digital atlas, the researcher had a larger role in directing how the tool was designed and used than was ideal for PAR. The research community as defined in Chapter 3 is also not a traditional grassroots community found in many PAR and PPGIS projects, but rather a select group that held

technical and academic expertise. The main challenge, and where I believe the PRB digital atlas project met a shortfall, was in populating the user base with members of local communities in the PRB, including First Nations. Ultimately, the tool was not picked up by a grassroots community organically and many local community and First Nations community members did not find it a useful or needed platform at this time. Intensive outreach and education to local community members and between ENGOs who might have an interest in conservation mapping in the PRB would be required to build a broader, grassroots community of use.

6.3.1 Recommendations for Further Research

The PRB digital atlas tool could be used as a hub and platform for First Nations and other community mapping projects in the PRB, which would certainly enrich the data. The barriers to the digital atlas' usefulness come primarily from the fact that First Nations and government tended to have more sophisticated GIS programs with dedicated staff and extensive libraries of critical datasets and maps. First Nations in the PRB are engaged in counter-mapping with these tools in their community, and the PRB digital atlas was a redundant tool. Though some of the datasets I made available were used by First Nations and other land-use planners, they found the Data Basin tool itself unsuitable for their projects. Similarly, government agencies in the PRB have their own internal and public databases with exponentially larger and more powerful GIS capabilities. It is perhaps unrealistic to expect one tool to be the sole platform for community conservation mapping in the PRB, but the digital atlas could be refined and expanded to be a useful resource and supplement primary databases and processes used by First Nations and other communities.

Land-use planners I interviewed explained where they could find the tool useful:

> *"I think that kind of information would be an asset, whether it comes from a member of the public or whether it comes from a university or a proponent even or a client that we may have. That type of anything like mapping can be really useful. So as far as you know having another map platform that kind of allows people to do [counter-mapping] and be a repository for information, that's I think, a good thing." (LUP 2)*

> *"I think it will really help of the scoping of the actual work being open with the community of where they can map. We're pretty good with our system of uploading things in generating reports…but we need to focus on the actually use and where we can do the mapping."* (LUP 3)

Further research investigating the compatibility and utility of the PRB digital atlas, or other platforms, to help build capacity in parallel processes and create a supportive climate for public participation in conservation mapping, with public access to comprehensive information could be helpful (Barndt, 2013). While the digital atlas was designed to overcome the technical barriers associated with GIS platforms, a dedicated GIS technician would still be required to support training and outreach for its widespread use among community members.

6.4 Final Thoughts: Counter-mapping Conservation with a Digital Atlas

This thesis research through a digital atlas case study determined that the tool and Data Basin platform can provide a useful framework for better informing conservation research, decision-making and advocacy. It helped enrich the data for conservation priority-setting and advocacy, and brought more voices from a variety of communities into the process. However, to be successful, the PRB digital atlas would need to be significantly scaled up, both in datasets available and users engaging with the tool. The manager of a project like this must have technical skills in research and GIS manipulation in order to populate the library of available datasets, which involves detective work in tracking down existing conservation data that is widely scattered, protected and in some cases forgotten.

The digital atlas tool was intended to be offered for use to a broad community of interest, including not only staff and contractors with Y2Y and myself, but also individuals with an interest in conservation in the PRB and beyond. To this point, however, the tool has primarily found use from a select handful of Y2Y staff and myself, with little use coming from the grassroots. This limited the community of interest to well-educated professionals with a specific bias and interest in how the tool should be developed and used. Intensive outreach and education to local community members and between ENGOs who might have an interest in conservation mapping in the PRB would have been required to build a broader, grassroots community of use.

This research also required the researcher to be a community organizer—despite a stated need for the PRB digital atlas from the Y2Y/NRESi workshops, the number of actual users from those workshops and other communities of interest were few. Counter-mapping with a tool like this will require a robust, well-funded and travelling outreach and training campaign with a social marketing component. The growing use of internet and 'cloud'-based data sharing means that this outreach and training could be unnecessary for the quick sharing of mapping data among conservation advocates and community members.

Overall, the potential of the PRB digital atlas to be a platform for conservation counter-mapping in the Peace is promising. Visualizing values and threats on the landscape at multiple scales can be highly impactful on public consciousness and awareness and can strengthen the case for conservation/better management. Creative visualization of conservation imperatives with real-time or regularly updated GIS data and modeling, coupled with the prospect of broad dissemination through an online platform, has clear potential for generating public support and engagement to advance conservation goals. Digital conservation atlases present

opportunities to contribute to public knowledge campaigns through the production of visual representations that relay information about the importance of protected spaces as a counter to the exponential growth of industrial resource development.

However, many barriers, including time, cost, and expertise, remain unmitigated despite the good intentions of Data Basin's developers. Further research is required to more fully understand these barriers, and develop solutions, to make a digital atlas truly user-driven and empower communities through counter-mapping to have more control of decision-making over their land, air and water.

Maps are undeniably powerful tools, and the process of their development is a critical component of how land can be altered, or protected. GIS has been a ubiquitous tool for conservationists since for more than 30 years, and the development of the technology has created new ways of visualizing and analyzing landscapes. In developing the digital atlas tool, I came to recognize quickly how the creation of maps can drive decision making and priority setting for land-use and conservation advocacy, and how lines drawn on a map can create a simplistic understanding of a complex landscape. At the same time, GIS can be used to ask new questions and look at scenarios that are not just spatial, but also temporal, social, or cultural. Examples include forecasting future land-use changes, models of landscape permeability and connectivity, and the potential for real-time understanding of wildlife movement to guide conservation decision-making are all exciting potentialities of the technology.

As mapping technology advances rapidly, the role of social sciences in deconstructing the accompanying power of maps, data, and access will need to advance with it. Changes in the technology will result in changes on the land, often at an increasing pace.

This research has shown that these tools are not immediately able to remove the power imbalances in mapping, but they can be used to disrupt these relations. The positionality of the researcher and mapper, the costs and barriers to information, and the way in which that information is displayed are important factors that need consideration as they variously can result in the replication of power imbalances and dispossession of authority and power for some community constituents.

In some cases, such as the technical and training barriers, digital atlases can replicate the power affects of mapping. In others, such as making datasets readily available to a public audience, they can work to disrupt the expert/custodian monopoly on information and its display.

Counter mapping in practice is not as simple as one community using maps to speak back to an authority. It is a practice that is integrated in the entire mapping process, from the collection of data, to decisions how and where that data is displayed in a mapped form. Counter mapping is an ongoing, living practice, requiring the practitioner to constantly assess and reassess their position relative to the communities they are engaged with. The power dynamics of mapping are also fluid, where the role of the researcher or mapper in relation to communities is not always clear-cut. For conservation decision-making, counter mapping presents an opportunity to better engage with local communities at an early stage, avoiding conflict later on in a land-use process. Tools that enable counter mapping and greater

community participation in map-making, and in counter-mapping, offer an exciting opportunity to accommodate multiple voices, visions, values, and realities of place and land.

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Appendices

Appendix 1: Letter of Informed Consent

Informed Consent

You are invited to participate in a research study that will investigate the best practices to develop a publically accessible (e.g., web) spatial mapping database for the Peace River Break that brings together a combination of community and traditional knowledge and values along with scientific and technical information. This information sheet provides you with additional information about a) the purpose of this study, b) what you are being asked to do, and c) your rights as a participant. If you have any questions about the study or what is requested of you, please feel free to ask any questions you may have before participating using the contact information provided below.

Title of Study: Design of a Spatially-Based Conservation Decision-Making Platform for the Peace River Break

Principal Researcher Pamela A. Wright, Ph.D.

Affiliation Associate Professor, University of Northern British Columbia: Outdoor Recreation and Tourism Management/Ecosystem Science and Management Program. Contact by email pwright@unbc.ca or telephone (250) 960-6353.

Research Assistant Tim Burkhart, Graduate Student NRES

Affiliation University of Northern British Columbia: School of Natural Resources and Environmental Studies. Contact by email burkhart@unbc.ca or telephone (250) 815-1071 (cell).

Purpose

The purpose of this research project/internship is to investigate the best practices to a) develop a publically accessible (e.g., web) spatial database for the Peace River Break that brings together a combination of community and traditional knowledge and values along with scientific and technical information and b) to develop a prototype of that database. This is an applied research project that includes an exploratory research phase and the development of a prototype spatial database that can be evaluated by partners and stakeholders. This project is part of a research project conducted by Pam Wright and Tim Burkhart and will also be used to inform Tim Burkhart's masters' thesis.

How You Were Selected & What You Are Asked to Do You were identified as someone interested in conservation and land-management strategies for the Peace River Break region through participation in previous meetings or workshops in the Peace River Break area or by others active in the community. This study will involve the researchers conducting indepth interviews with participants and participating in mapping sessions together to identify information needs, mapping approaches, data display/sharing techniques, and potential data usage needs for conservation strategies in the Peace River Break. To help in the research process we would like to record our interviews and meetings ; the audio will be used only for

transcription purposes and no identifying information will be transcribed. All transcription will be completed by graduate research student Tim Burkhart. If you choose not to be recorded we will revert to note taking.

Confidentiality and Anonymity No names or identifying information will be included in the dissemination of the interview results. Code numbers will be used on the interview records to protect your identity. Your name will only appear on the consent forms, which will be kept separate from the surveys in a locked filing cabinet or password protected hard drive in a locked research office at UNBC that is accessible only to the researchers Pam Wright or Tim Burkhart. Any data that is entered into a computer will be encrypted, password protected, and also stored in a secure office.

Right to Decline or Withdraw Your participation is completely voluntary and you may choose to withdraw at any time during the study without penalty of any kind. If you decide to withdraw at any point before the study is complete, the information that you have provided thus far will be destroyed.

Disposal of Data All data will be kept in a secure location at UNBC in a locked cabinet (with interview records kept separate from personal information) for five years after the completion of the study. The data will then be destroyed by shredding interview records and consent forms, and by deleting all computerized data files (including information on electronic storage devices).

Potential Risks There are no known or anticipated risks to you by participating in this research, however, we do anticipate that there may be significant benefits as your

participation could help strengthen the design of the geo-spatial conservation decision-making platform.

Dissemination of Results Once the study is complete, a report will be produced resulting from the project and as part of Tim Burkhart's masters research. Any information that you offer in terms of your responses in the interviews or on the surveys will be summarized in the study's report, and therefore, your responses will be kept anonymous and will not be personally identifiable. At the end of the study, a final report of the findings will be produced and made available to all participants upon request. Work resulting from the final report will also be submitted to peer-reviewed journals for publication.

Debriefing At the end of the study, participants can request a copy of the final research report by contacting Pam Wright at (250) 960-5363 or via email at pwright@unbc.ca.

Other important Information and Contacts If you would like to verify the ethical review of this study, or raise any concerns that you may have, please contact the Office of Research at the University of Northern British Columbia at (250) 960-6735 or via email at reb@unbc.ca.

Research Participant Consent Form

- I have read the above information concerning the study entitled, "Design of a Spatially-Based Conservation Decision-Making Platform for the Peace River Break."

- I understand that I am being asked to participate in a research study and I have received and read an information sheet that describes the study.

- I understand the conditions of my participation, including the requirement to participate in an informal interview and that my responses to any questions will be kept confidential (only the two researchers named in the information sheet will have access to the information I provide).

- I also understand that there are no known or anticipated risks to me by participating in this research.

- I have had adequate opportunity to consider the information in the document, and to discuss or ask questions pertaining to the study. I understand that my participation in this study is entirely voluntary and that I may refuse to participate or withdraw from the study at any time without explanation or penalty of any kind.

If you agree to participate in this research project, please sign below:

Organization _____

Printed Name _____

Signature _____

Date _____

Appendix 2: One-on-One Interview Topics

Design of a Spatially-Based Conservation Decision-Making Platform for the Peace River Break

One-on-One Interview Topics

Interviews will be semi-structured and target interested individuals involved in conservation initiatives in the Peace River Break area to find a range of perspectives on what information, mapping approaches and data display/sharing techniques would be strategically important and appropriate for better informing a regional conservation strategy.

The researchers will be searching for information in relation to the following topics:

Interviewee Background

- Describe your interest in conservation in the Peace River Break.
- What types of resources, places, or activities are important to you in the region?
- What type of cartographic tools and techniques are you familiar with and how have these contributed to your conservation interests in the Peace River Break?

Identify the interviewee's information and data usage needs as pertaining to their conservation interests in the Peace River Break region.

- What type of cartographic or 'mappable' information would be useful in facilitating your organization's conservation goals?

- Are you aware of any information that has already been mapped by yourself/your organization/other organization?
    - How accessible have you found this information? Is it available online? Is it readily understandable and useful?
- How do you envision this information being represented on a map, how would you prefer to see it visualized online (ie. In plain map form, interactivity, photographic, captioned etc…)?
- Do you perceive this information as useful in increasing public awareness and engagement in working towards your conservation goals?

Identify any concerns or conflicts with displaying this information in a web-accessible, online platform for sharing with the general public and/or other stakeholders.

- Do you see strategic value in displaying this information publically?
- Would this representation help to accomplish your own or your organization's conservation goals?
- What concerns do you have with the translating this information into a digital, mappable format?
- What type of information or data would need to remain private and not shared with the public?
- What type of information or data would need to remain private from the public, but would be appropriate to share with interested conservation stakeholders or partners?

Appendix 3: Coding Structure/Codebook

Information sources:

- Semi-structured interview conversations with key informants involved in the design of previous conservation plans or similar analysis and with partners and stakeholders in the Peace River Break region. Includes GIS experts or professionals in the mapping and land-use fields, local 'lay-people' with little to no mapping experience, and conservationists with a direct interest or partnership within the Digital Atlas project.

- Notes taken to collect and codify data generated in key informant interactions around the planning, design and communication of the project case study, including through electronic communications, phone conferences and other meetings.

Overview:

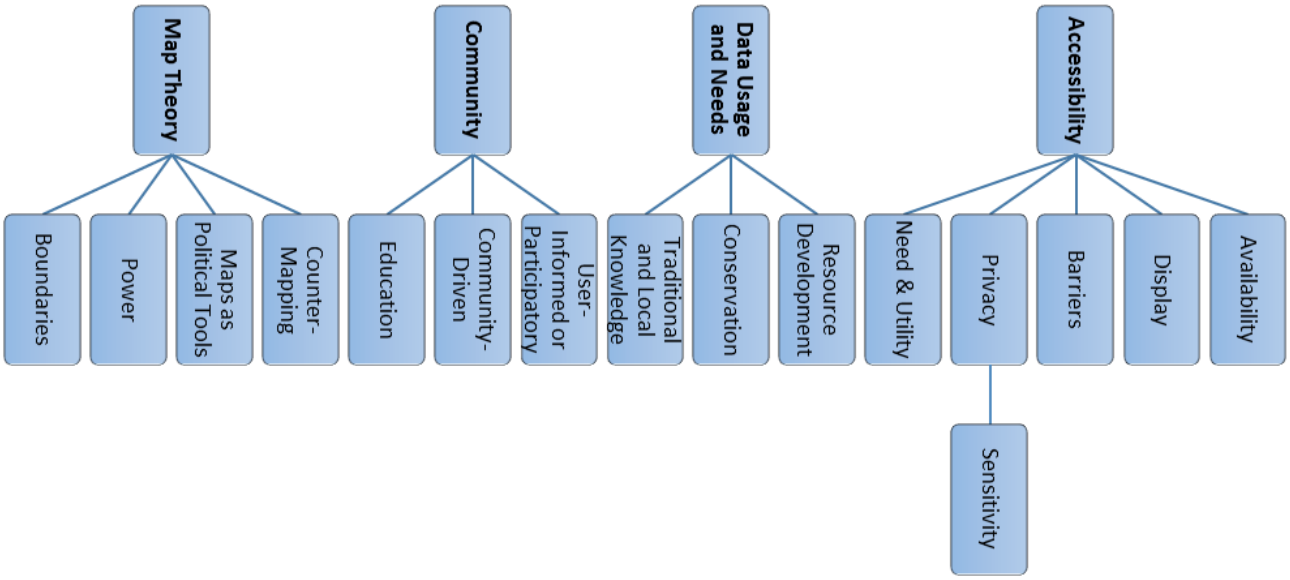
I looked at coding via three broader themes or categories chosen both as their connection to my research questions and as what I know to be emergent from the text of interviews, notes and my journal. Accessibility, the ability of users to access and easily view maps and mappable data for their own interest on the land-base, is an important component of counter-mapping, and was brought up as a major issue in multiple interviews, as well as being a major piece of putting the case study digital atlas together. This includes barriers to getting the data or visualizing the mappings to suit the user's needs, as well as issues of privacy and sensitivity of certain data that may or may not be problematic to present publically.

The second theme was Data Usage and Needs, and specifically points to what information the interviewed communities would find useful and desirable in an online atlas. While simple,

mentions of resource development or specific geographic features could have an interesting relationship with the availability or unavailability of data and the power of mapmaking, so I think it worthwhile to code these.

Community represents the third thematic category, and refers to the needs of local communities', individuals' or groups' participation and interest in digital atlas or other mapping tools. As the project case study was itself community-driven, the amount of ongoing interest will be valuable data.

The final broader theme is tied more to the theoretical framework of my research questions, lying with the power of maps and maps as political tools and objects with inherent biases. These themes will intersect with the other categories.



Categories and Codes:

- **Category: Accessibility**

How available and accessible is mapping information that would be useful for land-use planning, conservation and public understanding of land-use and development in the Peace River Break? What barriers are there to accessing and understanding this information?

- **Availability**

  Text coded to mentions of where and how easily can the public obtain and use mappable information.

  Inclusion Criteria: Mentions of other digital mapping programs or websites, professional mapping companies or booklets, government or industry maps.

- **Display**

  Text coded that identifies how maps or mappable data are displayed, or suggestions for how they should be displayed. Code medium mentioned or preferred as child-code ie.:

  - Publically
  - Privately
  - Online
  - Paper
  - GIS
  - PDF

  Inclusion Criteria: Mentions of best way to view maps, or if speaking of specific map how it was displayed or presented.

- **Barriers**

  Text coded that offers insight into what is preventing the public from obtaining and using mappable information. Barriers might include technology or knowledge, or the willingness of map or data custodians to share information.

  Inclusion Criteria: References to difficulty accessing or finding or displaying maps or mappable information.

- **Privacy**

  Text coded to issues of privacy, confidentiality or sensitive information. Text coded to indicate what information is not appropriate for public dissemination and why

  Inclusion Criteria: References to not allowing information to be shared in a specific manner.

  - **Sensitivity**

  Text coded to concern about the display or acquisition of cultural, ecological or geographic materials.

- **Need & Utility**

  Text coded to issues of usefulness of proposed Digital Atlas or other atlas', what gaps the project could fill, what redundancies exist with other like tools.

  Inclusion Criteria: Include references to failed projects or other atlases, as well as mentions of the existence of other tools (such as iMap or Google Maps) as more likely to be used in place of PRB Atlas.

- **Category: Data Usage and Needs**

  Identify information gaps, mapping approaches, data display/sharing techniques, and potential data usage needs. What types of mappable information would be useful for local land-use decision making and display of the land and why?

  - **Resource Development**

    Text coded to identify specific interest in capturing resource development activities in mappings. Might include:

    - Oil & Gas
    - Forestry
    - Mining
    - Site C

    Inclusion Criteria: Could include other geographic features if mentioned in context of resource development.

  - **Conservation**

    Text coded about specific conservation mapping, principle or need brought up in interview. Might include:

    - Caribou
    - SARA
    - Animal Tracking

Inclusion Criteria: Could include other geographic features if mentioned in context of conservation need (ie. Enduring Features analysis).

- **Traditional and Local Knowledge**

  Text coded to need for or awareness of mappings or mappable traditional and local knowledge, including First Nations Traditional Ecological Knowledge, local sites of interest or recreation, cultural use sites or local descriptions of place.

  Inclusion Criteria: Include with mentions of local or traditional knowledge in conjunction with Privacy/Sensitivity code, includes trails, hunting or fishing spots, and also ways of concealing or buffering information on a map in order to protect the knowledge.

- **Category: Community**

Identify cases where maps or mappable data was sourced, produced or used by communities.

- **User-Informed/Participatory**

  Text coded to reflect instances of where a mapping project, atlas or interest in the PRB Digital Atlas was centered on a 'crowd-sourced' aspect, whereby the users of the tool or participants in a project were driving or had major input in the final result.

  Inclusion Criteria: Mentions or references to the actual *use* of maps or tools such as the Digital Atlas.

- **Community-Driven**

  Text coded to reflect instances of where mapping or land-use was community drive, or the usefulness of a Digital Atlas could enhance community-driven land-use projects/proposals by using collaborative and open techniques based upon the volunteered input into common Internet resources.

  Inclusion Criteria: Mentions or references to the *building* of maps or tools such as the Digital Atlas.

- **Emergent Code: Education**

  Text coded to reflect references or insight into education programs or institutions that could be useful to or find useful the Digital Atlas tool.

  Inclusion Criteria: Include references to webinars, training, or schools.

- **Category: Map Theory**

  How do the elements of a map, the way the land and certain features are visualized, and the existence or absence of features or maps work to empower or disempower local communities and conservation efforts? Instances of maps neutrality questioned or affirmed.

  - **Counter-Mapping**

    Text coded to instances or insight into the use of maps as a tool to use against power structures such as government or industry, or maps produced specifically to counter other maps.

    Inclusion Criteria: Mentions of making maps for advocacy, prompts to specific counter-mapping question.

  - **Maps as Political Tools**

    Text coded to the ways the land and features are represented through various rhetorical styles and technical processes can be seen as means of expressing control over the image of that landscape. Instances or insights into where maps have been used as instruments of power used to impose the biases and desires of their creators upon the landscape itself.

    Inclusion Criteria: Fairly subjective, but essentially a contrast to Counter-Mapping code; instances where maps are used to impose a powerful institution's will on the landscape. (Ie. BC Hydro maps of Peace river valley, Forestry maps showing OGMAs)

- **Power**

  Text coded to insights into the concept that maps are socially constructed texts that must be negotiated and understood in the context of the power and ideology inherent in map-making.

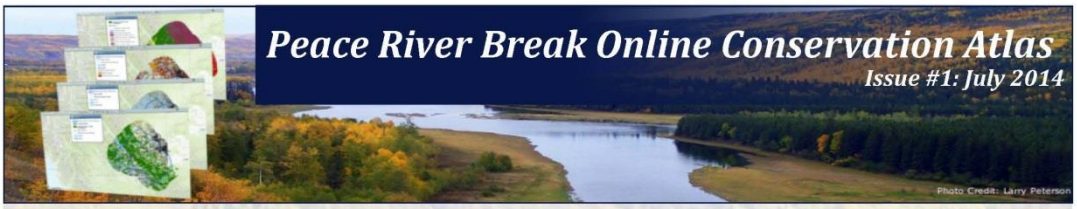
  Inclusion Criteria: Overlaps with previous two codes, but also standalone instances or mentions of the 'power of maps' or means by which maps assert their own truth or accuracy.

- **Boundaries**

  Text coded to mentions of the challenges and effects of delimiting conservation or other land use objectives within specific, fixed boundaries. Instances or insight into where the map becomes the territory.

  Inclusion Criteria: Mentions of boundaries or borders, or decisions made for conservation or other land-use purposes based on pre-existing mapped boundaries.

Appendix 4: Newsletter



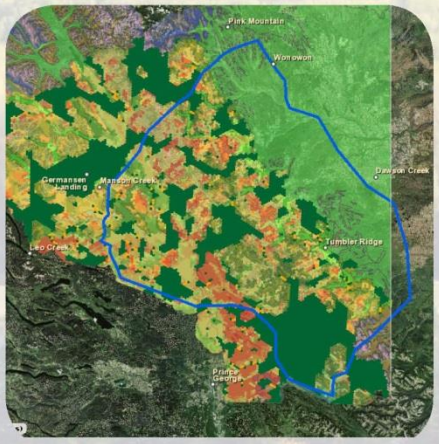
About

The Online Conservation Atlas is a comprehensive source where you can discover, visualize and analyze conservation planning data for the Peace River Break.

Utilizing the Data Basin platform, this Conservation Atlas is designed to promote the open exchange of critical conservation information and help build a clear conservation strategy between partners, the public, stakeholders and policy-makers. Users can search for maps and spatial data sets, visualize the results of conservation projects in the region, and learn about conservation science and design for the Peace River Break.

This data can be used to identify critical wildlife crossings, maintain ecosystem connectivity, identify core conservation areas, maintain socially/culturally significance places, and assess the cumulative impact of rapidly expanding industrial development in the region.

We encourage you to explore the PRB Online Conservation Atlas, contribute to the vast array of content, and join in cultivating a one stop-shop for conservation data in the Peace River Break Region.



About the Partners

The University of Northern British Columbia, in partnership with Landsong Heritage Consulting, Ltd. and the Yellowstone to Yukon Conservation Initiative and with funding support from Mitacs, a national, not-for-profit research organization, have developed a publicly accessible geo-spatial database to help inform conservation planning for the Peace River Break.

How to use the Atlas

- The Atlas is a tool for collaboration. Users can upload and share data, set permissions on data sets, and collaboratively visualize map products.
- Users can visualize and examine spatial data on aquatic and terrestrial habitats, combined human access, intact forest landscapes and land use information, and many other datasets from a wide range of sources.
- Mapping tools to visualize and overlay the various layers witin the Alas, and the broader Data Basin archive are also available.

The Atlas Allows You To:

- download scientifically-credible datasets
- upload datasets as public or private
- organize content into your own private workspace
- save maps, drawings, and comments
- create galleries and groups
- contact and work with other members

In this Newsletter

YELLOWSTONE TO YUKON CONSERVATION INITIATIVE

UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

LANDSONG HERITAGE CONSULTING LTD.

Step 1: Go to Databasin.org

Data Basin is a web-based platform that integrates science, mapping, and people, supporting users with a wide range of technical capabilities.

- Mapping tools to create beautiful custom maps
- Group and personal workspaces for collaborating and getting work done effectively
- Powerful search engine including geographic area of interest
- Upload/download of biological, physical, and socio-economic geospatial datasets
- Privacy controls to limit access to content
- Drawing, analysis, and commenting tools

Step 2: Sign Up

To create a free account, click on the **'Sign Up'** link in the top right or go directly to http://databasin.org/auth/create_account

You can also sign in to Data Basin using an existing Google, Facebook, or Yahoo account.

Step 3: Join the Peace River Break Group

To join the PRB Atlas, email ***burkhart@unbc.ca*** your Data Basin Username and you will promptly be added to the Atlas Group so you can get started!

Step 4: Become an Active User

- Explore the datasets housed in the atlas
- Create overlays to address your questions
- Make custom maps to examine relationships between land-use, habitat, protection, resources and much more...

The Atlas contains a collection of maps that can be easily customized by users and a collection of spatial datasets in GIS format that can be downloaded. Each map and dataset is accompanied by information (metadata) to support their use and interpretation. Maps and data have been grouped into Galleries that correspond with major projects to help usersfind the maps and data they need as easily and quickly as possible.
The components that make up the Data Basin platform include:

Datasets: Data Basin contains geospatial information that resides in datasets—spatially explicit files that can be uploaded, downloaded or visualized in a web mapping service. Datasets are the basic building blocks of a map or gallery. A dataset could be coordinates where a specific species has been observed, vegetation types, or the results of a model that highlights ecosystem services.

Datasets must be ESRI Shapefile, File Geodatabase, or ArcGRID formats inside a layer package file (.lpk), which is an ESRI proprietary file similar to a .zip file. This means that in order to upload data, a user must have access to ArcGIS, as other systems such as QGIS cannot be used to create layer package files. Datasets must be in standard projection based on the following Datums: WGS84, NAD83, South American 1969, European 1950. Upload files must be less than 250 MB.

Maps: Maps are visualized datasets created with easy-to-use tools in Data Basin. Maps, customized by users, can be kept private, shared with groups, or published for everyone. Users can critique maps with provided drawing and commenting tools. More hands-on analytical tools are currently being developed.

Galleries: Galleries are meaningful collections of datasets and/or maps created by Data Basin users. Users and organizations can publish galleries (including studies, atlases and books) that others can easily find and use.

People: Data Basin utilizes social networking tools to connect its users for collaboration. Users can search profiles to find data providers, potential collaborators or interested audiences, send messages, and create and join groups.

Groups: Groups are user-defined subset of Data Basin users collaborating around a specific topic or issues. Group members can share, analyze, and discuss datasets and maps. Data Basin allows for private (closed) and public (by request) groups. At this time, the Peace River Break database is a closed group.

Centers: Centers are topics or geographies of special interest to Data Basin users. Users can find specific datasets, maps, galleries, people, groups, and analytical tools under each center.

My Workspace: My workspace provides a private area for accessing Data Basin. Users can easily organize content they contributed or found in the system. Users can create and edit personal profiles; manage their account; track creation of datasets, maps, and galleries; and, manage their group activity.

To Watch an Introductory Video to Data Basin, visit:
https://www.youtube.com/watch?v=KTcSuyr_oW4

About Tim Burkhart

Tim Burkhart is a graduate student in the Natural Resources and Environmental Studies department at UNBC, where he is studying critical cartography in relation to conservation strategies, design and campaigns. His interests are in how participatory mapping strategies can enhance support for conservation campaigns, and how counter-mapping can enable conservation practices beyond fixed boundaries. In his undergraduate career Tim studied History and Political Science at UBC, and his experience includes most recently working as a Park Facility Operator in the southern gulf islands. In the past Tim has worked as organizer on multiple political, non-profit and labour campaigns, and as a historical researcher on the Cohen Commission.

We encourage you to use the Online Conservation Atlas to help make a positive difference for the well-being of people, wildlife, and natural landscapes in the Peace River Break. As we continue to develop this exciting project, we want to learn more about what users are doing, what information is useful, what's missing, and how we can build and tailor the Atlas to better suit the community's needs. Your feedback is important to the success of this project, and we'd really like to hear from you!

For more information contact:

burkhart@unbc.ca

or visit

blogs.unbc.ca/peace-conservation

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Appendix 5: Press Release

UNBC graduate student Tim Burkhart is aiming to empower more people to get involved in land use planning by making it easier for them to access and interact with mapping tools.

Media Release (11/10/2014) Prince George, BC - As part of his research towards a Masters of Arts in Natural Resources and Environmental Studies, Burkhart has created a digital atlas of the Peace River Break region. The Peace River Break is the narrowest point of the Rocky Mountain range and is located almost entirely within BC's provincial borders.

Burkhart says that in the past, comprehensive maps were held by private or public agencies and consequently difficult to access or required specialized training to understand. The online atlas is designed to be simple to use yet still provide detailed information about the region.

"The idea for the Peace River Break digital atlas Project is to create a give-and-take relationship with the public," Burkhart said. "I would like to see people using it for their own specific conservation goals, whether it's a local group looking to protect a specific wetland or someone who wants to identify hiking trails."

In addition to using the data for their own purposes, members of the public can collaborate with other users through the imbedded communication tools. Burkhart said the opportunities for map users to engage with each other sets his project apart from traditional maps.

"Maps have an intrinsic power to them because they purport to accurately represent the land," Burkhart said. "What you put forward with your map has the power and potential to change that landscape."

Burkhart's research is funded by Mitacs, in collaboration with Yellowstone to Yukon and Landsong Heritage Consulting.

Appendix 6. Monkman Provincial Park Candidate Boundary Amendment